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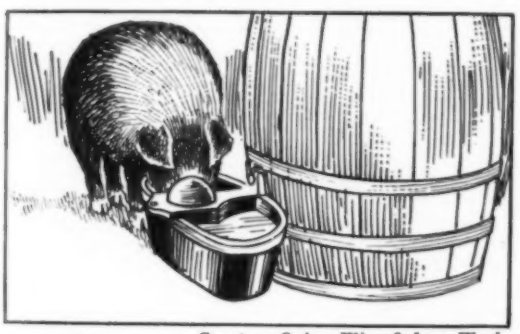
Castings Supply Drinking Water for Livestock

WHILE one little pig may have wandered away to market and there procured such important items as food and drink, the other little pigs that remained at home depend entirely upon the stockman for such necessities of life. The owner of any kind of livestock constantly is confronted with the problem of supplying fresh, clean drinking water for



Courtesy Quinn Wire & Iron Works

Castings Are Used Extensively in the Construction of Drinking Fountains for Livestock

his livestock. While these needs may be provided with comparative ease during the summer months, the process often becomes exceedingly difficult when the north winds bring forth ice and snow. Various types of watering devices have been developed to solve this difficulty, and in practically all instances, castings are used extensively in the construction of the troughs. One type of fountain may be attached to the lower part of a barrel or stock tank, where it is within easy reach of the smaller stock. This unit consists of a bowl built of a gray iron casting, a strainer of malleable cast iron and a valve assembly constructed of brass. The flow of water into the bowl of such a unit will take care of 300 head of hogs or sheep a day. A heating unit, designed to operate 40 hours on one filling of oil, is placed directly under the water bowl and the heat is carried to all parts of the unit through the iron casting. Many dairymen also provide individual cast fountains for watering stock in stalls.

Find where castings can be sold.

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Produces Cores With Speed and Accuracy

By Fred B. Pletcher

IN THE core making department of the Nash Motors Co. foundry, Kenosha, Wis., where the castings for the company's Kenosha, Racine and Milwaukee automotive works are produced, careful planning and prudent investment in advanced equipment have helped synchronize operations into more steady servicing and output with remarkable compactness of working units. The equipment includes seven continuous gas-fired ovens—three horizontal and four vertical. Two of these horizontal ovens in which the cores are baked have capacity for 60 to 80 core racks each in the baking chambers.

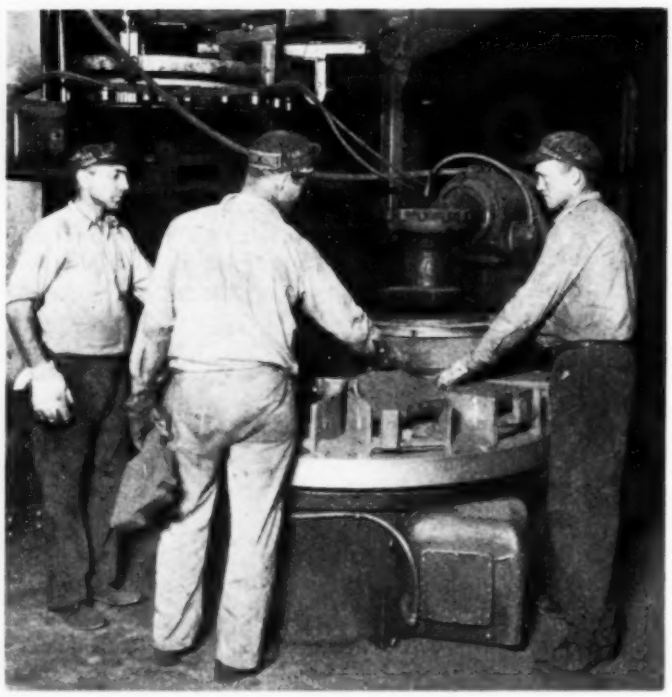


Fig. 1—Eleven Jigs Are Mounted on the Table of the Grinding Machine

The core making department is typical of refinements looking to space economy that have gripped the attention of the motor car manufacturer for some time. Without adding appreciably to working areas, a well defined trend has been to expand output schedules and at the same time to make one foot of floor space do the work of two or more. The Nash core making department actually has made each square foot more than double itself in efficiency through the use of modern production methods.

The newer methods have cut down costs while at the same time production of cylinders, cylinder heads and transmission case castings has been doubled. In the core making department, up to 240 tons of core sand are handled in an ordinary working day. Two men and a crane operator mix and distribute the sand to the core makers, while a fourth supervises the entire baking operations. In preparing and distributing core sand, the methods and equipment have been worked out by the foundry management with a view of obtaining maximum efficiency from the labor expended, and at the same time reducing costs wherever possible. To this end much labor of a nonproductive nature has been eliminated. The core making department and cleaning rooms occupy the space to the right of the center aisle in the foundry. Core sand is prepared in two mixers made by the National Engineering Co., Chicago. While one of the mixers is operating, the other is being filled from the eight large hoppers suspended under the sand storage. These adjoining hoppers, are gravity filled from the storage above, and extend downward into funnel mouths spaced so that a clam shell bucket mounted on a car running on a narrow gage track easily can be filled with any grade of sand contained in the various storage hoppers.

The track runs to the side of the mixers, where the loaded bucket is raised and its contents dumped into the mixers by an electrically controlled hoist, supplied by the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y. The hoist suspended from an overhead monorail system is operated by a 220-volt 10-horsepower motor controlled through four push buttons by an operator on the floor level. Each of the hoppers is marked. Four contain lake sand, three a bonded sand and one silica sand

A 2-ton crane made by the same company distributes the sand to the core machine storage bins. These hold enough, usually for 1½ hours.

Two parallel trolley single chain and roller conveyor systems, each built close to the floor and each winding a loop or oval course over the core area, are served by the core machines. Both of these with the loaded traveling core racks, enter the covered incline at the west end of each of the two horizontal baking ovens, loop horizontally through the oven two and a half times, and emerge at the exit incline at the opposite end of the ovens, making a total of 1050 feet in conveyor length for each of the two systems. Ten core sand bins line the aisle side of the first conveyor system, and similar units are stationed along the left, or outside, of the second oval conveyor line. Each bin serves two hand jolt core machines furnished by the International Molding Machine Co., Chicago. Inside each oval are six more bins, which serve two core machines each. The core machines on the outside of the oval conveyor lines are for transmission case cores. Benches line the curved ends near the mixing machines

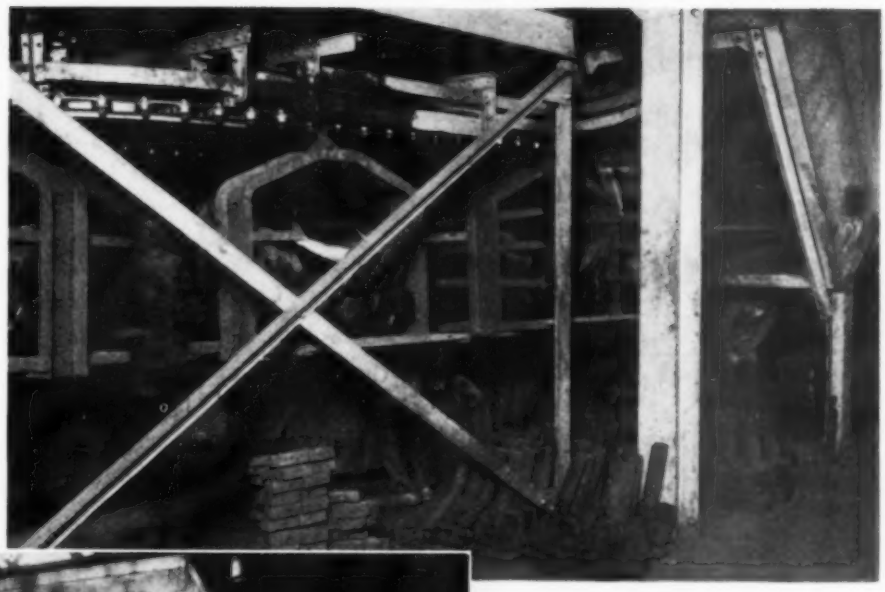
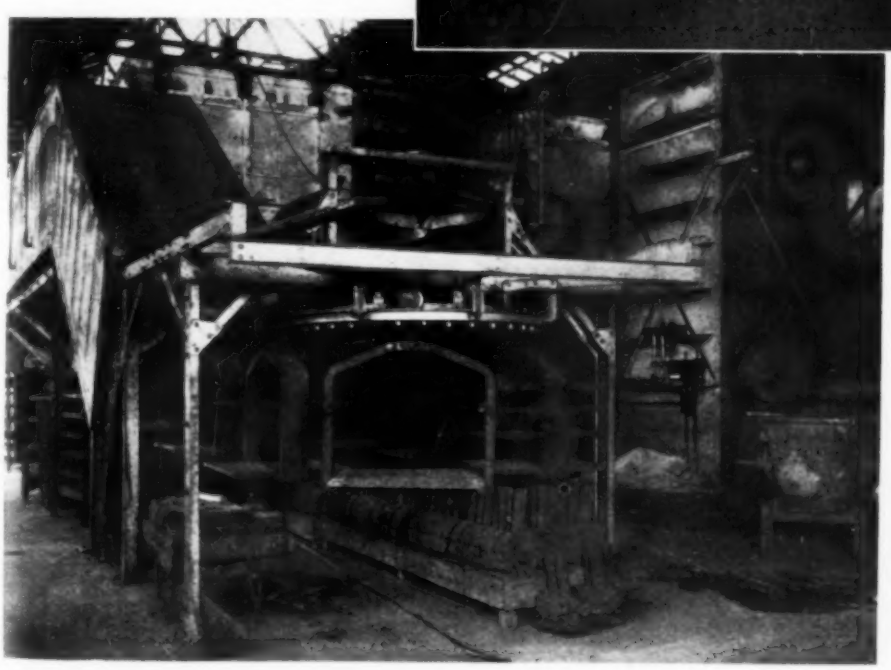


Fig. 3—(Left) One of the Large Horizontal Gas Fired Core Baking Ovens. Fig. 4—(Above) Entrance Incline to Horizontal Drying Oven

Fig. 2—(Below) Exit of One of the Horizontal Core ovens Vertical Drying Ovens Are Shown at the Right



and along the north wall for the making of valve tappet and numerous small cores. The bins and machines inside the oval enclosures supply cores for cylinder heads and blocks, gear cases and valve chambers. When the lines emerge from the baking ovens, they swing around to a huge core storage rack with 25 runways, capable of holding 5000 cores on the shelves. The cores are loaded on aluminum trays in such order that when they reach the opposite side they can be removed in the order in which they are needed for molding.

After removal from the racks, the cores are cleaned, gaged and inspected. Two vertical spindle grinding machines grind the jacket cores to size. The table of each grinder contains 11 jigs which hold the cores so that the upper part of the core presents a plane horizontally to the grinding wheel, and in such position that excess thicknesses may be removed easily. The height of the table may be adjusted to meet all requirements as to thickness. A third similar machine on the molding floor side

Fig. 5—(Above) Receiving End of Light Bench Core Oven Showing Working Space Underneath. Fig. 6—(Right) Core Rack Conveyor

is for grinding cylinder block cores.

The cores then are placed on another loop rack conveyor where the cores are blacked enroute to the entrance incline of a horizontal gas fired drying oven 4½ x 6 x 80 feet, made by Young Bros Co., Detroit. This oven is in line with the two baking ovens. Emerging from this oven, the cores are received in pairs for delivery to molding units or for jacket and cylinder head assembly floors, which occupy the remaining northeast space of the core department proper. The assembled cores are dried in two vertical or tower ovens 5 feet 7 inches x 7 x 32 feet at temperatures of 350 degrees Fahr. One of these ovens was built by Young Bros. Co., Detroit, and the other was furnished by Mahr Mfg. Co., Minneapolis.

Core breakage has become negligible as a result of the complete continuous conveyor lines in the core making area. Servicing of core sands is under scientific control. Sand test readings are taken frequently.

While the foundry in the past has reclaimed as high as 30 per cent of its burnt sand, fresh sand now is used daily for coremaking. Most of the core boxes are aluminum. At the machines the cores are turned out on flat steel plates for the traveling racks.

Remarkable economy in core baking is reported as the result of the installation of the two large horizontal continuous core baking ovens, claimed to be the largest ever built. These gas-fired ovens, also were installed by Young Bros. Co., Detroit. Each oven is 200 feet long, with baking chambers 16 feet 1 inch wide and 10 feet 8 inches high, outside measurement.

The design and construction of the horizontal baking ovens permits the utilization of virtually the entire floor space underneath for core conveyors, and core making operations. The bodies of the parallel twin ovens are tied into the north side building walls. Both are carried on structural steel framework, and have clearances of 8 feet from the floor level to the oven supporting beams, except under the entrance and exit inclines.

No discomfort is felt by workmen in this space under the ovens, as it is possible to maintain ordinary room temperatures, even during baking operations. Fresh air is brought from the outside by a fan.

The core knockout is beneath the main ovens. The burnt sand passes outside on a belt conveyor over a magnetic separator. The core filing and finishing departments also are beneath the main ovens.

Gas pressure is maintained at about 5 pounds per square inch with a motor driven positive action blower supplied by B. F. Sturtevant Co. Inc., Boston. The provisions for recirculation of heat and the ventilation have made possible the baking of both large and small cores simultaneously with excellent results, and with few or no rejects. The sizes of the cores vary from 60-pound assemblies 10 to 12 inches thick to small cores 1 inch thick.

Satisfaction is reported also in the simultaneous baking of the various types of cores. Baking time for the mixed loads is the same as that for the small cores alone. Baking time

Data on Vertical Core Ovens

	FIRST OVEN	SECOND OVEN
Weight of racks and 4 shelves, pounds	255	130
Number of racks per hour	23.2	25.6
Hours of run	7 hr. 35 min.	7 hr. 15 Min.
Daily Summary		
Output per day, dry sand, pounds	8,984.5	6,015.2
Weight plates and driers, per day, pounds	45,406	25,306
Weight other iron, i.e., rack, chain, etc.	82,600	64,110
Weight iron per day, pounds	128,006	89,406
Gas for day's run—cubic feet	25,560	20,794
Hourly averages		
Output dry sand, pounds	1,185	830
Weight plates and driers, pounds	5,980	3,490
Weight, other iron, i.e. rack, chain, etc.	10,910	8,830
Weight total iron, pounds	16,890	12,320
Gas consumption, cubic feet	3,120	2,650
Iron to sand ratio	13.4 to 1	13.9 to 1
Cubic feet gas per pound, wet sand	2.48	3.24
Cubic feet gas per pound, total material equivalent to sand (3 pounds iron thermally equivalent to 1 pound wet sand)	0.490	0.581
Coverage of shelves, i.e. percentage of shelf area covered by area of plates	57.5	22.3
Percentage shelves filled with present method of loading, i.e. 4 plates per shelf	87.6	35.6
Percentage heat utilized in heating material	59.5	51.0

is up to 3½ hours, with averages having been maintained of 2 hours and 41 minutes. The control system is sufficiently flexible for alterations of the time temperature cycle for the accommodation of changes in type or weight of cores run or binder used. The first stage of the passage of the cores through the ovens permits a gradual heating until all the moisture in the cores is driven off. From the point at which the volatiles are removed from the cores, only sufficient heat is added to maintain a baking temperature. The baking temperature for the cores is maintained up to a maximum of 450 degrees Fahr.

The longitudinal dividing wall in each of the baking ovens makes each side independent so far as temperature control is concerned. The 24 burners are distributed along the oven floor and are fired horizontally in a direction counter to the movement of cores through the oven, thus facilitating the ventilation. Each burner has a special inspirator which collects the proper amount of air for combustion.

To accommodate the degree of heat desired at certain points, a range of 8 to 16 burner tips are mounted on each burner. The flame from each jet impinges upon a fire brick surface at a sharp angle, which aids in the recirculation of heat. Individual pilot lights fed from an independent gas supply are a further operating safeguard for each burner. Automatic baking temperature regulation is obtained by six temperature controllers on each oven. Recording instruments made by Leeds & Northrop, Philadelphia, control groups of four burners.

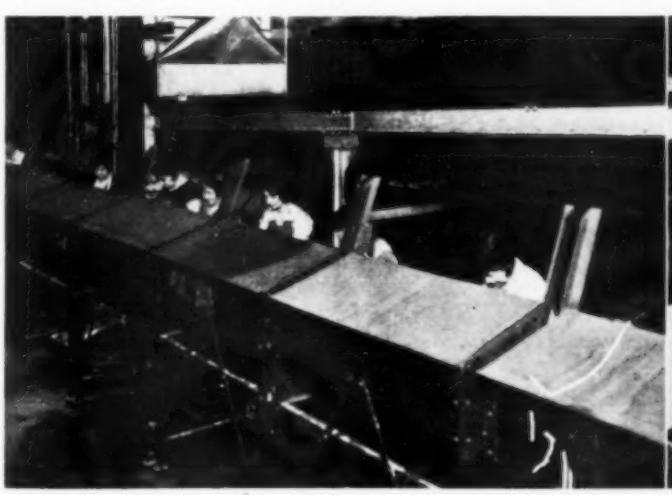
The core racks 5 x 5 feet are equipped with adjustable shelving to accommodate the various sized cores. Special compartments thus are provided for heavy cores. Each conveyor carries 156 racks, spaced 5 feet 6 inches on centers. The production rate in cars per hour for each oven ranges from 22 to 44. Operating at 36 inches per minute, one conveyor carries about 4000 square feet of shelf area into its oven per hour. The speeds of the conveyors are controlled by speed reducers made by the Reeves Pulley Co., Columbus, Ind. Speed reducers also are used for the continuous vertical drying ovens.

Fig. 7—Receiving Core Sand From One of the Eight Hoppers

On the molding floor side, just opposite the mixing machines at the west end, a space is set aside for baking light cores. Girls work at the benches on a steel mezzanine floor, serving the upper burners of two vertical baking ovens. These ovens have three and four burners each. Here continuous rack conveyor systems move the cores into the entrance chambers of the ovens. On the ground floor just below, the rack conveyors complete their course and emerge again. At this point the cores are at the cleaning and filling sections for this type of cores. Ample storage space provides for their final arrangement, according to needs. Baking time in these vertical ovens averages about 1 hour.

Recent analysis of the vertical core ovens has disclosed that two methods of changing the operations of the ovens slightly have tended to reduce gas consumption per pounds of sand and the iron-to-sand ratios. First, the speed of the conveyor chain was reduced sufficiently to allow the racks to be completely filled. At the same time the temperature was reduced sufficiently to compensate for the longer time the cores remained in the oven. The second method also was to reduce the speed of the conveyor. Then the bottom burners were turned off after the oven was up to temperature. The temperature at which the oven was to run depended upon whether the decreased heating zone compensated for the longer time the cores remained in the oven. This method increased the cooling space in the oven and consequently a more efficient recovery of heat from the cores by the incoming cold air was claimed. The accompanying table shows data summary of the vertical core ovens.

The results accomplished by the use of the most advanced equipment and methods are reflected in all divisions of the foundry. The careful selection and arrangement of sand handling and mold equipment, with mechanical handling facilities, characterizes the molding floor as well as the core department. Every advantage has been taken to supplement intermittent operation by the use of continuous operation with a resulting large increase in production.



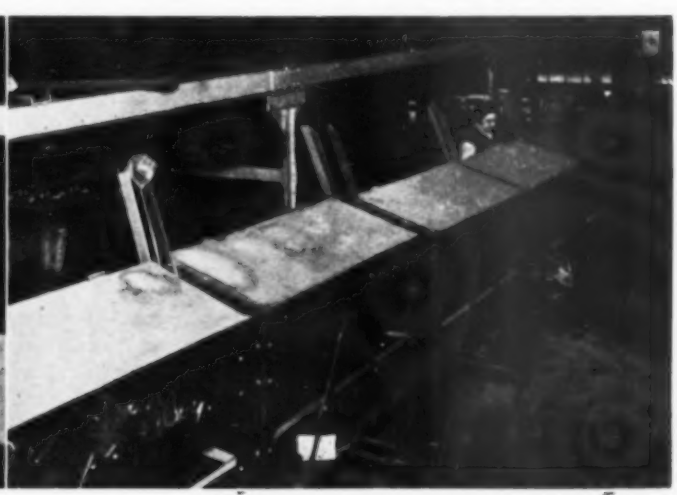


Fig. 8—Loading End of Vertical Core Oven on Upper Oven Deck. Fig. 9—Showing Bench Core Work and Loading Station close to the ovens on the mezzanine floor

Defects in Cast Brass Are Revealed by Deep Etching

By W. F. Graham and L. A. Meisse

INVESTIGATION of ferrous metals by means of so-called deep etching and subsequent macroexamination of the surface has been applied extensively in recent years. In the literature there may be found well-illustrated examples of the results of this test, as shown by Keshian, *Transactions* of the American Society for Steel Treating, 1927, but there seems to be little work done in its relation as a tool for the uncovering of defects in nonferrous metals and alloys. In this article it is attempted to describe briefly some typical results obtained in deep etching these latter materials, especially the brasses and bronzes, to bring out more clearly defects in the metal which otherwise would be invisible to the naked eye.

Dissolve Discontinuity Areas

Deep etching is accomplished by the attack of reagents which will react rather violently with a smooth surface of the metal or alloy. The reagents tend to eat away the points or areas of discontinuity of the structure, which may be caused by sonims (solid nonmetallic impurities, crystal boundaries and, in certain materials, by dendrites. In general, the clean metal as represented by the mass of the crystals is not attacked. The degree of the attack of the reagents will, of course, vary with concentration, time and temperature.

The test procedure should be adjusted so that the attack does not progress to such an extent that the results of the differential etch of the inclusions is over emphasized. It is the object of the test to reveal the presence of inclusions; and, after they have been revealed so that they are visible to the eye or under low magnification, there is no further necessity of developing them by continued etching.

The actual mechanics of the attack may be explained by the common electrolytic theory of corrosion in which there is a couple set up between the dissimilar constituents in the matrix. In the case of nonferrous alloys, the etching attack may proceed on dissimilar constituents which may be forced out at the grain boundaries. In all cases, however, in the application of this test the body of the crystal, even though composed of a solid solution of a cored nature, will be in a slight relief to that of the grain boundary. The grain boundary will be traced slightly by the etching reagent and if there are no inclusions the specimen will have the appearance of a mass of clean bright crystals.

Test Is Valuable

CONSIDERABLE data on investigation of ferrous metals by deep etching has been published, but little has been done on nonferrous metals. Work done by the authors of this article shows that deep etching will reveal not only inclusions and character of metal from oxidized or reduced standpoint, but also porosity, laminations or actual fissures. This paper is abstracted from a paper presented at the annual convention of the American Foundrymen's association held in Cleveland, May 12 to 16. The authors are associated with the technical division of the Ohio Brass Co., Mansfield, O.

Our application and experience with deep etching has been confined chiefly to investigation of the structure of cast red brasses, that is, alloys containing copper, tin, lead and zinc of the approximate composition 85-5-5-5 and variations thereof. However, we have applied the method in some cases to yellow brasses, phosphor-bronzes, gun metal and some special nonferrous alloys, and the results which we obtained were satisfactory.

It would seem that the proper etching reagent to use on red brasses is nitric acid. Nitric acid attacks the alloy violently, generating a considerable amount of heat. For this reason the action is a quick one and the test can be accomplished in a short time. In the use of concentrated nitric acid alone it was found that the tin, particularly when over 2 per cent, was oxidized to meta-stannic acid. This insoluble coating promoted a differential attack which was misleading.

To overcome this difficulty, 10 per cent hydrochloric acid was added to the etching reagent, thereby keeping the tin oxide in solution and thus resulting in a clean surface on the specimen. The actual procedure in treating a given specimen depends somewhat on its size and shape, but for specimens not greater than 3 inches square and ½ inch thick, we have found that an 8-minute immersion in a solution of nitric acid (1.42 specific gravity) with an addition of 10 per cent by volume of hydrochloric acid (1.18 specific gravity) gives, in general, a satisfactory etch.

The method can be varied and used to investigate the structure of quite large specimens by means similar to those used for the whole surface of steel ingots. Etched surfaces which have tarnished can be brightened by washing in chromic acid.

Reveals Many Defects

The deep-etching test will not only reveal inclusions in the casting and character of the metal from an oxidized or reduced standpoint, but also porosity, laminations or actual fissures which are not visible to the eye in the unattacked fracture. Fig. 1A illustrates blow-holes and other unsoundness in the boss of a casting from an alloy of the approximate composition of 84 per cent copper; 3 per cent tin, 3 per cent lead and 10 per cent zinc.

We have found a considerable number of inclusions in red brass of the composition 81.5 per cent copper, 3 per cent tin, 7 per cent lead and 8.5 per cent zinc melted in an open-fire type of furnace, as illustrated by Fig. 1B, showing the section of the hexagon portion of a valve body. The effect of hot pouring on light-section castings made from composition of copper 87.75 per cent, tin 5.50, lead 1.75 and zinc 5.00 may be seen in Fig. 1C. Specimen *A* of Fig. 1C is a sound casting and Specimen *B* is a defective casting, which the deep etching reveals by attacking the

juncture of the columnar type crystals as shown in the illustration.

Contamination of red brass by iron promotes serious difficulty in the machining operation. Fig. 1D illustrates a section of a casting of the same composition as that in Fig. 1B, in which there are considerable iron inclusions revealed by deep etching with nitric and hydrochloric acids.

The actual character of metal is not revealed wholly by fracture nor by examination of the machined surface. about the same results as sound, clean red brass. An example of this is shown in Fig. 2C, which illustrates a section cut from a yellow-brass composition ingot.

The effects of faulty gating, which did not properly feed a rather difficult casting to make, is shown by the deep-etched section illustrated in Fig. 2D. The facture did not reveal the areas of porosity uncovered by the deep-etch attack.

It has not been the intention to discuss at any great length the application of this test as a means of control by the foundryman of the quality of material that he may purchase or produce. However, it is desired to record the fact that the application of this test as applied to composition ingot has resulted, we believe, in a benefit in respect to the quality of the material.

A number of the refiners of secondary composition ingot are now making some use of this method as a control of their furnace operations, and our routine deep-etch tests of incoming shipments of ingot within the last year have indicated that there is a general improvement in the quality of the red-brass alloy with respect to oxides and other inclusions.

With respect to the results obtained by the test in the foundry, it is obvious that the porosity in castings can be determined quickly by the etching of sections. In standardization of melting practice, tying back to the character of the raw materials used as melting base, the deep-etch test is not only of interest but of positive value.

Unfortunately, red brasses are not sound materials in general, when examined from edge to edge; but fortunately, there is a sound skin at least on the edges of the casting section. If it were not for this latter condition, the foundryman would have a great deal of difficulty in producing a casting which would meet pressure test.

To overcome some of the extreme conditions which may cause trouble due to the porosity of the interior of the metal, it will be found that the application of the deep-etch test will provide a means for the foundryman to survey this condition and make the necessary corrections in his melting and molding practice.

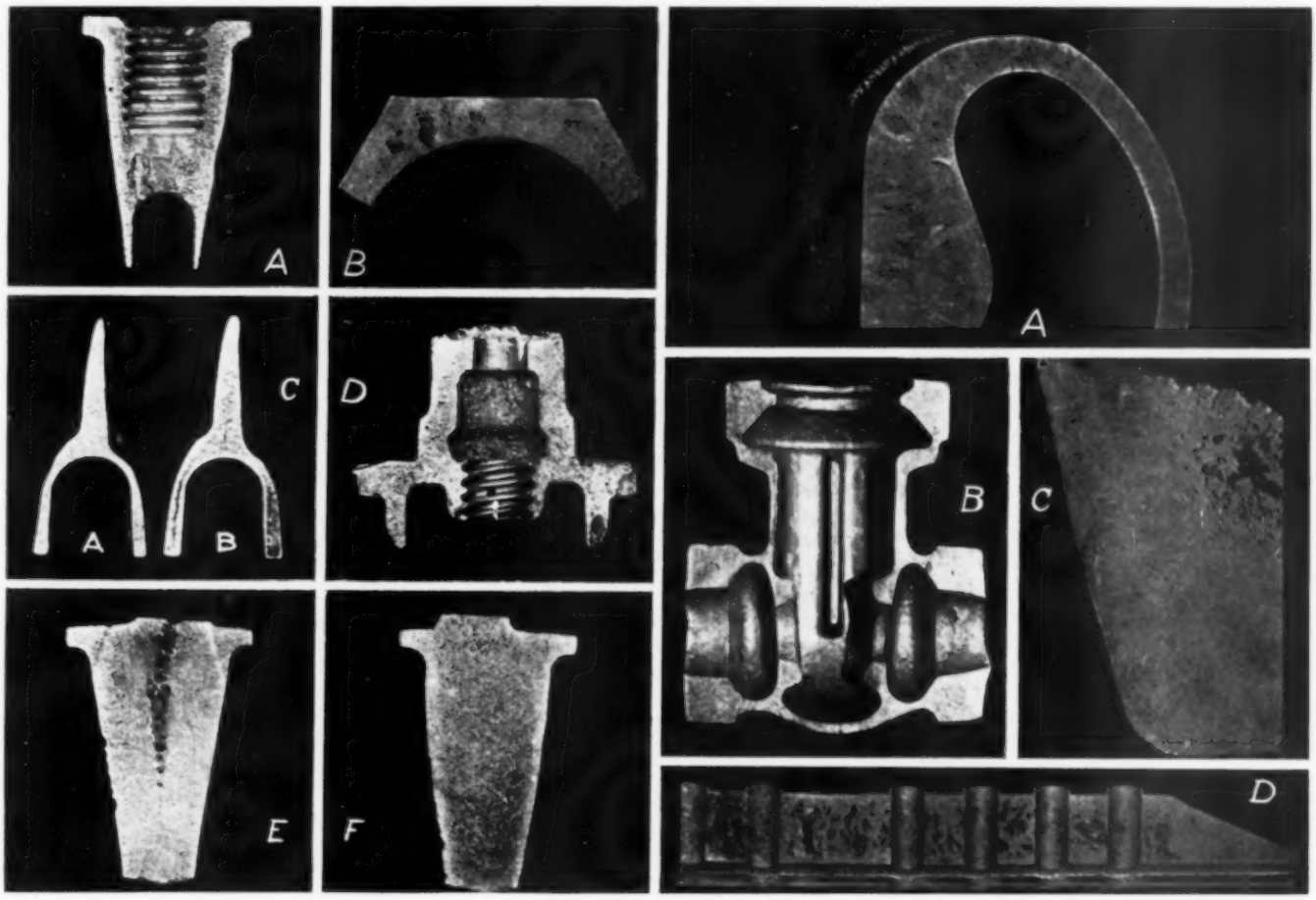


FIG. 1—LEFT—*A* SHOWS BLOWHOLES AND OTHER UNSOUNDNESS IN BOSS. *B*, INCLUSIONS IN HEXAGON PORTION OF VALVE BODY. *C*, EFFECT OF HOT POURING WITH SOUND CASTING *A* AND DEFECTIVE CASTING *B*. *D*, IRON INCLUSIONS CAUSING MACHINING TROUBLE. *E*, SHRINK IN BOSS OF TROLLEY EAR. *F*, SAME AS *E*, BUT SHOWING POROUS CONDITION THROUGHOUT. FIG. 2—RIGHT—*A* AND *B* SHOW SOUND METAL. *C*, SECTION OF YELLOW BRASS INGOT. *D*, EFFECTS OF FAULTY GATING AND IMPROPER FEEDING

Fig. 1E shows the shrink in the boss of a trolley ear which was not otherwise visible, and Fig. 1F shows a porous condition through the whole section; both of these conditions are revealed by deep etching.

The application of the deep-etch test to other alloys than red brass is shown by Fig. 2A, which illustrates the section of an aluminum bronze glider casting. This particular alloy and casting are remarkably sound and clean in the section shown.

An illustration of rather clean metal in a valve casting, similar in composition to that shown in Fig. 1B, is shown in Fig. 2B. Sound, clean yellow brass seems to deep etch with

GRAY IRON

Possesses

Valuable Engineering Properties

Part VI

THE transverse strength test is the most commonly used physical test for foundry irons. In this test a centrally applied load is placed on the test bar. The load is increased gradually until the bar breaks. The load at the moment of rupture is called the transverse strength or cross-breaking load. It is obvious that the load needed to break the bar depends on the size and shape of the test piece as well as on the intrinsic strength of the material. A larger bar will require greater load for breaking. Furthermore the stress required to break a bar of a certain iron of given cross section varies inversely as the distance between supports. The farther apart the supports the greater the bending moments, leverage effect and the less the load required for breaking.

As the load is applied the test bar bends or deflects and a stress-strain curve can be plotted, just as was the case in the tensile test. Such a transverse stress-strain curve is shown in Fig. 46. The total bend in inches in the center of the bar, at breaking load, is called the deflection. The deflections also vary with the size of the bar and the span, or distance between supports. Larger bars give lower deflection readings. The deflection increases as the span increases.

Use Transverse Test

ONE of the most commonly used physical tests for cast iron is the transverse strength test. To make comparisons of different cast irons it is necessary that the bars be of the same size and tested on the same span, or the values must be calculated to a common basis. For engineering purposes the transverse test has shortcomings, but the ultimate fiber stress of gray iron is shown by the modulus of rupture which can be calculated from the transverse test values. It also is shown that high deflection in a test bar does not necessarily mean that the iron has a greater shock resistance.

It is obvious that if different grades of iron are to be compared, either the test bars must be of the same size and tested on the same span or test results must be calculated to a common basis by the conventional beam formulas. As will be explained later the mathematical method is useful when intelligently applied. However, unlike most materials, cast iron changes markedly in its physical properties according to the section into which it is cast. Slower cooling as in a larger section usually causes decrease in strength. Therefore comparisons between different irons best are made in the same sized bars.

This has lead to the wide utilization of arbitration test bars of fixed dimension for comparative testing. There are several of these bars in common use. Included are these:

(1) A round bar, 1.20 inches in diameter and cast on end. This is tested on supports 18 inches apart. This bar is the present arbitration bar of the American Society for Testing Materials, and is the same size as the intermediate bar used in the British Engineering Standards specification. The Germans use a bar 30 millimeters in diameter which is practically the same as the 1.20-inch bar.

The arbitration test bar is used in the standard specification for gray

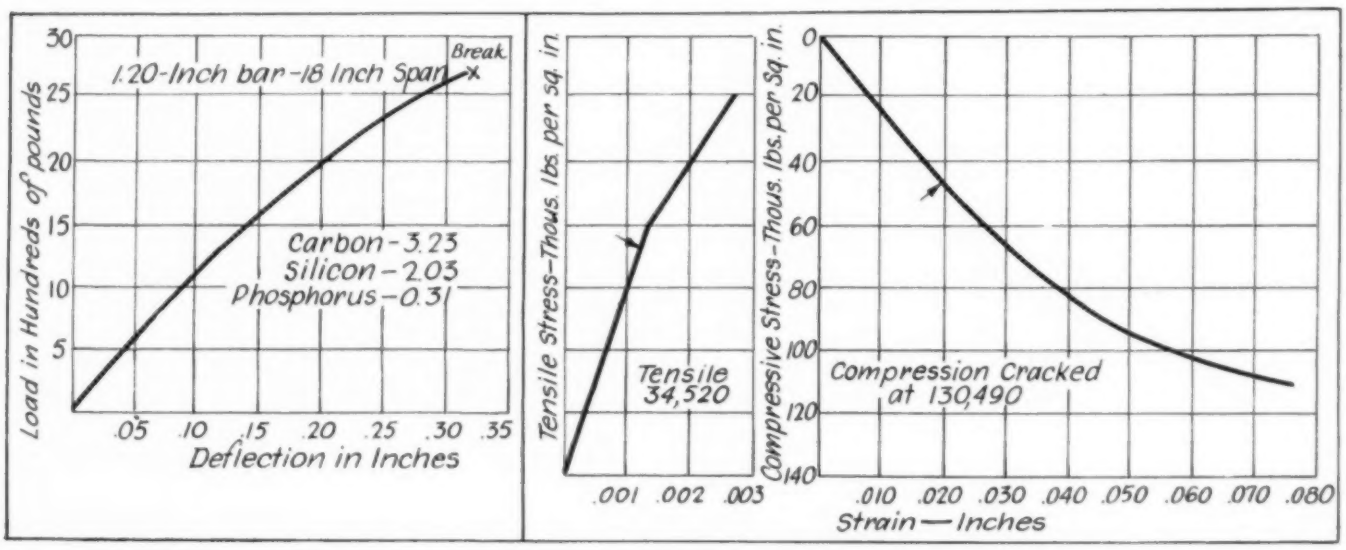


FIG. 46—STRESS-STRAIN CURVE PLOTTED FROM DATA OBTAINED FROM TRANSVERSE TEST. FIG. 47—TYPICAL STRESS-STRAIN CURVES OF A CAST IRON IN TENSION AND COMPRESSION ACCORDING TO COYLE

iron castings; cast iron soil pipe and fittings and high test gray iron castings. The minimum test requirements for these grades are shown in Table V.

(2) A round bar 1.25 inches in diameter cast on end, and tested on 12-inch span was the former arbitration bar of the American Society for Testing Materials, and for may years was used widely. American Society for Testing Materials specifications for this bar were:

Section	Breaking Load Pounds	Deflection inches
Light	2,500	0.10
Medium	2,900	0.10
Heavy	3,300	0.10

The loads shown are equivalent to those given for gray iron castings on the longer span smaller diameter bar.

The specifications for high test gray iron with the 1.25-inch bar were 3800 pounds breaking load with a deflection of 0.12-inch. This load indicates lower intrinsic strength iron than that indicated previously with the 1.20-inch bar for high test gray iron.

A rectangular bar 1 x 2-inch, cast and tested flat between 24-inch supports is used in the cast iron pipe industry.

A round bar 1.20 inches in diameter, cast on its side and tested on a 12-inch span was proposed by the valve and fittings industry and accepted by the American Society for Testing Materials as tentative standard for cast iron valves and fittings. It was recommended by representatives of the industry that the tensile test be made standard and the transverse test optional. The minimum requirements for the transverse test, when made, are as follows:

Grade	Breaking Load Pounds	Deflection Inches
Regular	2,500	0.10
High strength	3,300	0.12

A bar 1-inch square, cast on its side, and tested between 12-inch supports formerly was used widely, particularly abroad.

A round bar 0.875 inches in diameter is used in the British specifications to apply to castings up to ¾-inch thick. A 12-inch span is used. The minimum requirements are:

Grade	Breaking Load Pounds	Deflection Inches
A	1,185	0.12
C	960	0.10

A round bar 2.20 inches in diameter tested on 18-inch span is used by the British for castings over 2 inches thick. Minimum requirements are as follows:

Grade	Pounds	Inches
A	10,000	0.12
C	8,950	0.10

The transverse test has become used widely because of its convenience and simplicity. It undoubtedly is useful to determine degree of physical uniformity in irons in every day foundry operation. For these and other reasons there probably are over 25 transverse tests made to 1 tensile test. As an engineering test the transverse test has serious shortcomings. The transverse load has little direct engineering significance.

Designers calculate stresses in terms of tensile strength in pounds per square inch. The transverse load cannot be figured to true pounds per square inch. The nearest approach is through calculation of modulus of rupture, taking into account moments of inertia according to standard beam formula. The modulus of rupture, applied to an elastic material and within the elastic limit indicates the ultimate fiber stress in pounds per square inch.

When a test bar is supported between knife edges whose distance apart is L and a load S applied to the center, the bending moment on the bar is $LS/4$. The resistance of the bar depends on its intrinsic strength, in pounds per square inch, and on its shape and size. This latter factor depends on its section modulus, M.

Therefore $L/S4$=fiber stress in the bar multiplied by M.

Then the fiber stress=$LS/4M$.

The modulus of rupture represents the theoretical ultimate fiber stress at breaking load. For a round bar $M=\pi d^3/32$ where d equals the diameter of the bar. Substituting the various values, the modulus of rupture=$8LS/\pi d^3$.

For a rectangular bar $M=bh^2/6$ where b is the breadth and h the height or the load applied normal to b. Substituting again the modulus of rupture for the rectangular bar is $1.5LS/bh^2$.

To determine the modulus of rupture of any of the ordinary bars the load may be multiplied by the appropriate factor, shown in the right hand column of Table II presented previously in Part III. The modulus as calculated in this manner is much higher than the average tensile stress intensity as indicated in tensile strength pounds per square inch. The reason for this is that the characteristics of gray iron do not comply with the assumption involved in the derivation of the above formulas. For example gray iron on initial stress does not behave as an elastic material. It does not follow Hookes law exactly, the breaking stress is beyond any elastic limit, and the tensile and compressive moduli are not equal, This shifts the neutral stress axis, as the stress intensity varies in a not direct manner at distance X, X etc. from the geometric center of gravity.

Typical stress-strain curves of a cast iron in tension and in compressions are shown in Fig. 47, as determined by Coyle. The great differences between the strength and stiffness in tension and in compression are readily observed. This results in displacement of the neutral stress axis.

In spite of various shortcomings, the employment of moduli of rupture calculations appears to be the only logical means of making intelligent comparisons of various irons in various shapes and sizes of test bars. The breaking load for a given iron changes rapidly for alteration in sizes, the load increasing with increase in size of bar. The modulus of rupture, does not change so rapidly—it measures the relative strength, showing the usual decrease in strength per area to be expected in larger bars. In this respect it is somewhat comparable to the tensile figure. The

Table V

Minimum Test Values

	Breaking Load Pounds	Deflection Inches
Gray Iron, Light	1,500	0.20
Gray Iron, Medium	1,750	0.20
Gray Iron, Heavy	2,000	0.20
Soil Pipe & Fittings	1,500	0.20
High Test Gray Iron	2,500	0.24
British Grade A	1,950	0.15
British Grade C	1,600	0.12

Table VI

Test Bar Strength

Ladle	A	B	C
5	3,350	.....	.....
6	3,435	2,910	3,270
7	3,240	3,450	3,025
8	3,150	3,220	3,020
9	3,285	3,360	3,095
10	3,025	3,000	.....
11	3,240	3,150	3,060
12	2,840	2,815	3,020
13	3,055	3,120	.....
14	3,205	3,170	3,020
15	3,040	3,040	2,990
16	3,000	3,070	3,095
17	.....	3,045	2,945
18	3,270	3,075	3,215
19	3,175	3,150	3,190
20	3,100	3,135	3,090
21	2,935	3,015	.....
22	2,890	3,130	3,100
23	3,340	3,160	3,220
24	3,120	3,285	3,210
25	3,080	3,170	3,070
26	3,335	3,270	3,230
27	3,205	3,115	3,215
28	3,185	3,075	3,285
29	3,125	3,195	3,120
30	3,235	3,260	3,290
31	3,135	3,265	3,040
32	3,025	2,975	2,880
33	3,125	3,135	3,000
34	.....	3,020	2,950
35	3,120	3,150	3,150
36	3,075	2,950	3,025
37	2,910	3,030	3,035
38	3,205	3,075	3,115
39	3,270	.....	3,270
40	3,130	3,265	2,915
41	2,880	3,045	2,985
42	.....	3,020	3,035
43	2,985	2,890	3,090
44	3,140	3,165	3,180
45	3,125	3,110	3,045
46	2,975	2,780	3,030
47	3,225	3,145	3,105
48	3,120	2,885	.....
Average	3,130	3,100	3,092
Max.	3,435	3,450	3,290
Min.	2,840	2,780	2,880

tensile is much lower than modulus of rupture, largely because the tensile test bar in the larger bars comes from nearer the weaker center section of the bar and other reasons mentioned previously.

Fig. 25 previously presented in Part III of this series shows the modulus of rupture in relation to the volume to surface area which is proportional to the cooling rate, hence the section size of the casting. The figures in circles represent various types of cast iron shown in Table I, also given in Part III. Note that the low carbon, medium silicon irons

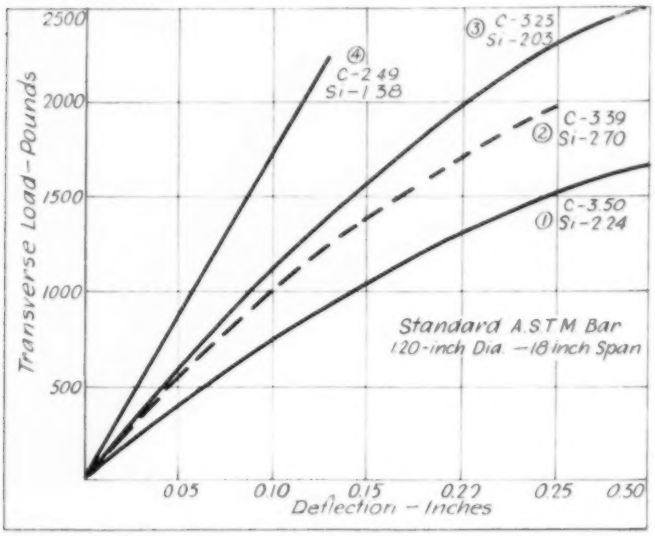


Fig. 48 — Curves Indicate that the Stronger Irons Have a Higher Modulus of Elasticity

Nos. 19 and 28 lose much less strength with increase in section than do the higher carbon irons Nos. 1, 4 and 5. Fig. 49 illustrates the drop in modulus of rupture and tensile strength in gray iron containing total carbon, 3.47 per cent and silicon, 2.75 per cent with different sized bars.

On another type containing carbon, 3.15 per cent and silicon, 1.90 per cent gave the following values:

Bar Diameter	Trans. Load	Modulus Rupture	Tensile Strength
1.0	1,625	74,425	40,260
1.2	2,513	66,595	38,150
2.0	11,525	42,990	29,240

J. G. Pearce, *Journal*, Iron and Steel Institute 1928 stated "The experience of the British Cast Iron Research association is that the transverse strength (rupture modulus) of a given iron is usually 1.8 to 2 times the tensile." In view of that and other similar results it appears unsafe to attempt to calculate tensiles from transverses by a fixed factor to be applied to any grade of iron and any sized test bar. For a given iron and a given bar a factor can be worked out experimentally which will serve for approximate uses.

Bars of rectangular cross section, yet of the same cooling rate as round bars, invariably show a lower rupture modulus than the corresponding round bars. Some have claimed that different crystallization characteristics inherent in square and in round bars explains this difference. On the other hand the rupture modulus formula when applied to cast iron becomes empirical, for reasons enumerated. It is not only possible but probable that the location of the stress center of gravity is different in each case. This factor is not easily determinable.

The outer layers of a test bar contain the stronger metal, as they are cooled more rapidly and finer in grain size. Notwithstanding this, when a light cut is taken off the bar, (just enough to clean it and true it up) the rupture modulus and deflection usually increase. A slight flaw on the tensile side of a transverse bar lowers the breaking load markedly. A sand cast bar's surface just under the skin gives more favorable test results.

In all true gray irons the intrinsic strength of metal in a series of bars or castings (poured under otherwise similar conditions from the same) decreases as the cooling rate becomes slower. Slow cooling promotes more complete graphitization and coarser grain size, consequently weaker metal. This influence was shown in Fig. 25. In test bars of given diameter the rupture modulus decreases slightly as the length of the bar as cast is increased. This was first noted by Matthews, *Proceedings*, A.S.T.M., 1910 and is due to the somewhat slower cooling of the longer bar.

Many attempts have been made to evaluate the mechanical properties of cast iron by formulas. One of the most common is to try to predict the tensile strength of irons of various grades from the transverse tests made thereon. While in iron of given analysis and manufacture, the relationship between given transverse and tensile bars is approximately constant, no such factor is of general application. One of the most common errors was to multiply the transverse load on the old 1.25 x 12-inch A.S.T.M. bar by 10 to get the corresponding tensile. One must be careful, on looking over old tables, to avoid tripping on some of these estimated tensiles, which may be 30 or 40 per cent from the actual value.

Deflection indicates how much the iron will bend at the breaking load. It seems that a brittle iron should bend less before breaking. On this basis the general opinion is that fairly high deflections are desirable and that irons possessing high deflection values have greater shock resistance. This opinion does not seem to be justified in view of our present knowledge of the fatigue and impact properties of the low carbon irons as compared to the higher carbon metals. As a matter of fact the shock resistance of the high strength low carbon irons may be 5 to 15 times that of weaker high carbon grades, and the fatigue limits are nearly proportional to the ultimate strengths. Yet the high strength metals sometimes have lower deflection values. For example note the following results using the average figures obtained on 1.20-inch diameter bars on a 18-inch span.

Carbon	Silicon	Transverse	Deflection
3.57	2.19	1,703	0.280
3.34	2.86	1,988	0.289
3.33	2.18	2,500	0.295
3.05	2.30	2,760	0.281

Increase in transverse from 1703 to 2760 pounds is accompanied by practically no change in deflection while the two intermediate group averages show higher deflections than either the low or high strength bars. MacKenzie has shown that deflection of the 1 x 7 x 24-inch pipe bar at 1500

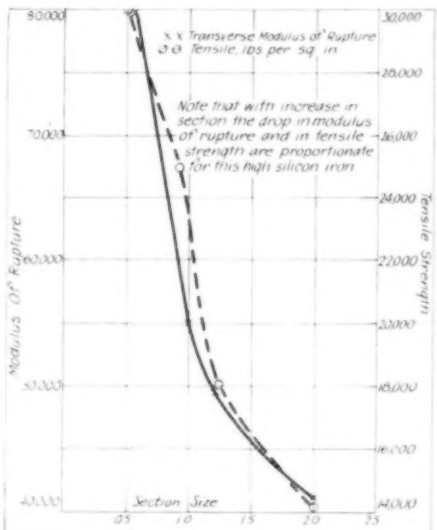

X X Transverse Modulus of Rupture
O O Tensile, lbs per sq. in.
Note that with increase in section the drop in modulus of rupture and in tensile strength are proportionate for this high silicon iron
Modulus Of Rupture
Tensile Strength
Section Size
0.5
1.0
1.5
2.0
3.5

FIG. 49—SHOWING THE DROP IN MODULUS OF RUPTURE AND TENSILE STRENGTH OF A GRAY IRON WITH DIFFERENT SIZED BARS

pounds is proportional to the sum of the percentage total carbon plus the percentage silicon. Bolton has shown that ultimate deflection of irons of given carbon and silicon content is lowered as the percentage of phosphorus is increased.

The stronger irons have higher moduli of elasticity in transverse as well as in tension, as shown in Fig. 48. Shock resistance is proportional to work done in tension or compression. It is quite evident that FS (force x distance) or work, is related to stress-strain. Thus an iron of higher strength and lower deflection may have more area under the curve.

All deflection tests should be made with measuring devices measuring the deflection of the bar, not the movement of the testing machine, or errors will occur. In Great Britain piston rings are tested by a modified transverse test as follows: An actual ring is split and then pulled apart by a load applied to the opposite ends of the gap, and at right angles to this diameter. The specification calls for a minimum load of 35,840 pounds per square inch as calculated from the following formula: $S=Pd/1200\ bt^2$ where S is the stress in pounds per square inch; P is the load in pounds; d is the external diameter of ring in inches; b is the width of ring in inches and t is the radial thickness (breadth of face) of ring in inches.

When operating conditions are under proper control uniform results are obtained on transverse tests. Results on 124 consecutive tests from a cupola are shown in Table VI. The ladles are numbered 5 to 48 inclusive. Bar *A* was taken from the first iron shanked from ladle, *B* from middle, and *C* from last. The blanks are where bars did not happen to be poured. No mixing ladle or forehearth was used. The transverse test will be used for many years to come for ordinary foundry testing. The modulus of rupture calculation will become more common. However, it seems probable that the tensile test will become more common for specification work.

Buys Drill Company

Independent Pneumatic Tool Co., 234 South Jefferson street, Chicago, manufacturers of electric and pneumatic tools and air compressors, has purchased the Cochise Rock Drill Mfg. Co., Los Angeles. This purchase is part of an expansion program inaugurated a year ago. The Cochise Rock Drill Mfg. Co. will operate as a unit of the Independent Pneumatic Tool Co.

First Issue of Steel To Appear July 3

The Penton Publishing Co., publisher of THE FOUNDRY has announced that beginning with the July 3 issue, *Iron Trade Review*, which has served the steel industry for 48 years under that title, becomes *Steel*. The new name has been adopted because it defines the scope and purpose of the publication more accurately.

Concurrent with the change in title, the format, arrangement of editorial and advertising pages, typography and other physical characteristics of the publication have been improved.

More emphasis is put on news articles and information of greatest interest to the largest number of readers. A digest enables the busy executive with only a few minutes at his disposal to "high spot" the week in steel. Greater opportunity is afforded for presenting and interpreting major news items effectively. "The Business Trend" is made more graphic through the use of color. Market reports are presented in more legible form and prices are quoted in larger type. *Steel* also presents a comprehensive digest of all significant activities in the technical operations of the steel industry, in addition to its usual articles on engineering practice.

To stimulate the preparation of better advertisements and to enable readers to derive the fullest values from advertising pages, advertising and editorial pages have been regrouped.

No change is made in the editorial policies which have carried *Iron Trade Review* from obscurity to a position of high rank in business paper publishing. To *Steel* is afforded greater freedom of action and increased opportunities for editorial evaluation and interpretation. In every respect the publication is more closely attuned to swiftly moving events in the steel industry.

Mechanical Engineers Nominate Officers

Nominations for officers of the American Society of Mechanical Engineers for 1931 were announced recently as follows: President, Roy V. Wright, managing editor *Railway Age*, New York; vice presidents, William A. Hanley, chief engineer, Eli Lilly Co. Indianapolis; Thomas R. Weymouth, president, Oklahoma Natural Gas Corp., Tulsa, Okla., Harvey N. Davis, president, Stevens Institute of Technology, Hoboken, N. J.; managers, W. L. Batt, president S K F Industries, Inc. New York; H. L. Doolittle, chief designing engineer, Southern California Edison Co., Los Angeles; H. L. Whittemore, bureau of standards, Washington. The following representatives on the American Engineering council also were named: W. R. Webster, Bridgeport, Conn., R. V. Wright, New York; J. W. Roe, New York; Robert Yarnall, Philadelphia; E. N. Trump, Syracuse, N. Y.; B. E. Hull, Houston Tex; E. O. Eastwood, Seattle, Wash.; W. Trinks, Pittsburgh; Warner Seely, Cleveland and William S. Conant, Washington.

Election of officers will be by letter ballot of the entire membership, closing Sept. 23, 1930.

Changes Company Name

The Parsons Engineering Corp. has been organized to succeed the Parsons-Thompson Engineering Co., Cleveland. Officers of the organization are as follows: President, S. S. Parsons; vice president, George Walzer; assistant vice president, Robert Wisely; treasurer, O. C. Sabin; assistant treasurer, F. C. Morey; secretary, Peter Reed; assistant secretary, C. W. Scott.

For some time the Parsons-Thompson Engineering Co. has been active as the western sales agent of the New Haven Sand Blast Co., New Haven, Conn. The company also has specialized in the design and manufacture of special foundry and cement mill equipment. Under the new name the company is enlarging its financial structure and scope of operation. Offices are maintained in Cleveland, Buffalo, Detroit and Chicago.

Institute To Expand

Mellon Institute of Industrial Research, Pittsburgh, will expand its facilities early this fall according to Dr. Edward R. Weidlein, director of the institute. The new structure will increase the laboratory facilities materially and will give more commodious quarters for general departments. The present library which includes 11,000 volumes will be expanded to accommodate 250,000. Larger chemical engineering laboratories also will be available and certain rooms will be equipped for specialized phases of experimental technique. Other special features of the building are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage.

W. L. Lewis, formerly assistant comptroller of the Bethlehem Steel Corp., Bethlehem, Pa., has been elected vice president, secretary and treasurer of the Chicago Pneumatic Tool Co., New York, succeeding J. G. Grimshaw, resigned.

Fig. 1—The Battery of 12 Machines for Making Pipe From 4 to 12 Inches in Diameter Is Arranged Across One End of the Building

Casts Pipe Centrifugally *in Sand Molds*

By Pat Dwyer

AN ALMOST continual program of expansion and improvement, a spirit of investigation and the willingness and courage to break away when necessary from established custom, all these features and many more have characterized the conduct and operation of the American Cast Iron Pipe Co., since the plant first was established in Birmingham, Ala., in the fall of 1905. The first pipe was cast in April 1906 and the plant has been in continuous operation since that time, probably the only pipe shop in the country running continuous operation, of three eight hour shifts and a five day week.

The first 16-foot lengths of cast iron pipe attempted in this country were made at this plant. The first effort of American pipe makers to utilize direct metal was tried here experimentally. Long before Ford perfected his present process for utilizing an electric furnace to superheat a mixture of cupola metal and direct metal from the blast furnace, the experiment had been tried at the plant of the American Cast Iron Pipe Co. Utilization of direct metal was abandoned as uneconomic under the then existing conditions and merely is referred to here as indicative of the pioneering spirit which constantly has actuated the management of this plant throughout its entire existence.

FIG. 2—A SMALL CUPOLA IS IN ALMOST CONSTANT USE

The most spectacular achievement up to the present, has been the introduction and development of the monocast centrifugal process for making cast iron pipe. The project was conceived by W. D. Moore, president of the company. His engineering and metallurgical forces were pressed into service. With characteristic zeal and energy the project was pushed through to completion in a remarkably short period.

Experimental work in centrifugal castings first was tried on a small scale in 1917. The work was carried on spasmodically for several succeeding years. Decision to build and equip an extensive addition to the plant for the express purpose of producing pipe by the new method was arived at on October 19, 1925. The first pipe by the centrifugal process in the new shop was cast on July 1, 1926.

Casting activities have been transferred gradually from the old pit cast pipe shop to the new centrifugal casting department. Pits and equipment still are maintained in the old shop, but are devoted principally to the production of large sizes of pipe. The bulk of the tonnage is turned

out in the new shop which can be operated on one, two or three 8-hour shifts depending on the volume of orders. Three shifts in a pipe shop apparently are as feasible as three shifts in a rolling mill.

The old shop was built at a time when the circular pit with an electric jib crane in the center was the accepted standard in the pipemaking industry. All the workmen in a pipe shop perform their various duties with a high degree of skill, speed and accuracy, but the craneman is in a class by himself. A natural gift of rhythm in time and distance, highly developed through steady application, enables him to manipulate ponderous loads with the grace and adroitness of a juggler tossing and catching in succession three oranges, an umbrella, a derby hat and a lighted cigar.

Standing on his platform he manipulates the various levers which control the movements of his crane as readily, surely and swiftly as a musician at a pipe organ. No organist who ever executed a difficult passage leading up to a grand finale, ever exceeded the skill and sense of rhythm displayed by the craneman in whipping a pipe flask out of the pit, swinging if from the vertical to horizontal, snapping it over the shakeout skids where the sand falls through a grating and the pipe rolls away and then depositing the flask in position where the halves may be clamped again. To the main theme of lifting, lowering and swinging the load, he adds a hundred little grace notes in the way of adjustments, compound movements and delicate twitches by which the hooks on the ends of his chains hitch and unhitch themselves In a word the craneman is an artist and the crane, despite its huge bulk, is an extremely sensitive instrument.

Loam cores for the pit cast pipe are swept up on a battery of motor-driven machines and dried in gas fired ovens. The cores are loaded on racks and the racks are lifted into and out of the ovens by the crane. The ovens are heated with byproduct gas, which, as stated in a former article in this series, now is cheap and plentiful in Birmingham.

Shows Progressive Trend

Method of firing these ovens furnishes another illustration of the progressive and, at times, radical views

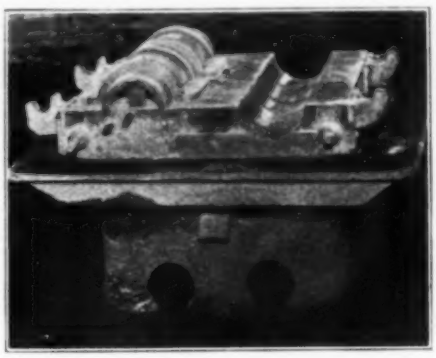


FIG. 3—SINGLE PATTERN PLATE SERVES FOR MAKING EITHER COPE OR DRAG OF A MOLD FOR FOUR HALF SLEEVES

of men who have stood at the helm and guided the operations of this plant. Direct coke firing was abandoned in favor of gas produced in a set of gas producers installed on the premises and fed with coke breeze, available in unlimited quantity at a nominal cost. This method remained in force until mains were laid for the present extensive distribution of byproduct gas from the coke ovens in the district.

The late John J. Eagan, while president of the American Cast Iron Pipe Co. instituted policies of cooperative management of the company's affairs. At his death, through his will, he established a trust fund of the common stock of the American Cast Iron Pipe Co. for the benefit of the employees and the purchasers of its products, the Golden Rule being the guiding principle in its operation.

For the workmen he provided a board of operatives to act as a means of cooperation between the workers and the management. The members of this board are elected annually from the ranks of the workers. This board has the privilege of making recommendations to the management on any subject it may deem of interest to the workers. Two of its members are placed on the board of directors of the company; two of its members act on the board of pensions, and it has standing committees on living conditions, housing, working conditions, wages, recreation, etc. By the terms of Mr. Eagan's will this board became one of the two trustees which control the common stock of the company. The trustees vote the stock of the company in the stockholder's meetings.

The company has an up-to-date medical building with physicians, surgeons, dentists and white and colored nurses. Visiting nurses attend the homes. Their professional duties include many items in addition to advice on many conditions besides sickness, safety and sanitation.

The company has a service building equipped with a gymnasium, locker and shower facilities, restaurant, recreation rooms, library, moving pictures, auditorium, educational rooms, community boys' rooms, etc. The plant Y. M. C. A. organization supervises and promotes activities in the field of religion, athletics, education, and community activities.

Other features obtaining at this plant include: employes' pension system, group insurance, unemployment insurance, one week vacation at Christmas time with full pay for all day wage employes, continuous ser-

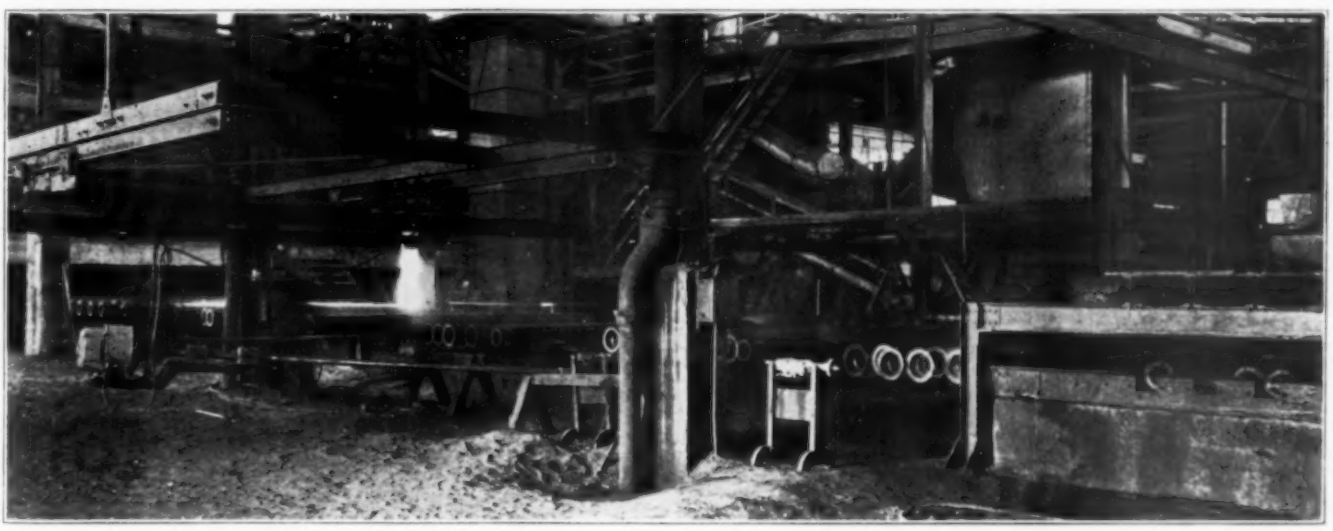


FIG. 4—A CONSTANT PROCESSION OF LONG, STRAIGHT PIPES ROLLS ALONG THE SKIDWAY WHERE THEY ARE INSPECTED AND AFTERWARD FINISHED BY GRINDING WITH SPECIALLY DESIGNED PORTABLE DEVICES

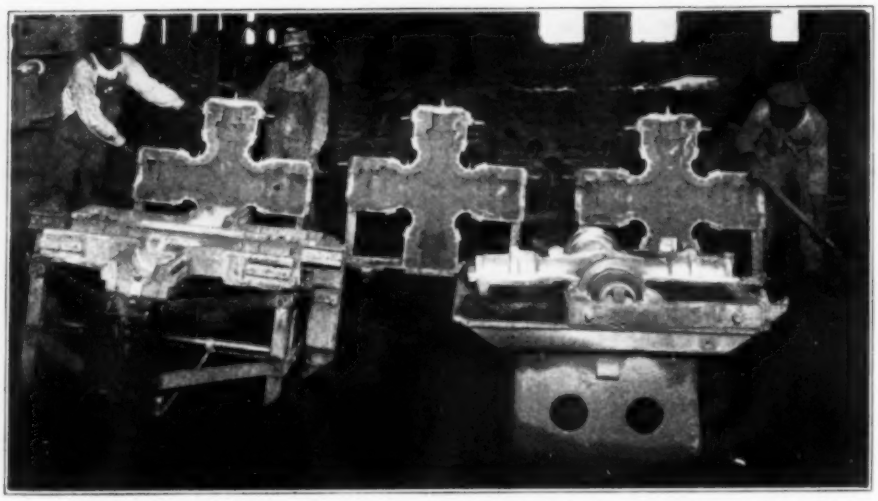


FIG. 5—THIS SETUP IS TYPICAL OF MANY EMPLOYED FOR MAKING MOLDS FOR STANDARD FITTINGS IN GREEN SAND

vice bonus of $2.00 per year of service, paid at Christmas time, sharing in the profits of the company, sickness and death benefits, opportunity to acquire preferred stock of the company as an investment, opportunity to acquire a home on the installment plan, the maintaining of a cooperative store, the maintaining of the Jno. J. Eagan fund for the relief of distress not otherwise provided for.

Methods of Manufacture

All of these activities and benefits for the employees, together with numerous others not mentioned, are provided by the company without cost of any kind to the men—no deductions made through the pay roll—and this work as a whole costs approximately 70 cents per day per man employed. In other words, if all of these benefits were eliminated there would be a possible 70 cents per day to pay to the men in direct wages, provided, of course, the efficiency remained the same in the absence of these services.

In the new plant where 4, 6, 8, 10, and 12-inch pipe in 16-foot lengths are produced by the centrifugal process, molten iron is poured into a rapidly revolving, horizontal, sand lined mold. Centrifugal force throws the molten metal against the sand face of the mold to form a tube of uniform thickness. The sand lining serves as a temporary insulating medium and causes the metal to cool slowly enough to produce a homogeneous gray iron structure in the wall of the pipe.

The plant in which these castings are made is thoroughly mechanized and to a great extent automatic. The sloping character of the ground on which the plant is erected, facilitates straight line operation from the west end where the metal is poured into the molds, to the east on a level, where the castings are cleaned, inspected, coated and shipped. The lower level is continued as a basement under that part of the floor supporting the operating machinery. This basement houses the sand preparing equipment, the bases on which the pipe flasks rest vertically while receiving their sand linings, the large claywash tank in which a revolving paddle constantly keeps the mixture uniform, the shakeout equipment and other items.

The upper floor is on a level with, and is a continuation of the floor for the pit cast shop. Seven 72-inch cupolas occupy part of the space on the line dividing the two sections of the building. A monorail system is employed to convey the metal from any of the cupolas to the centrifugal pipe shop in a 4-ton ladle. Three cupolas are operated by day and three by night. The seventh is held in reserve. These cupolas were built by the American Cast Iron Pipe Co. on blast furnace construction lines with bustle pipe and pendant tuyeres designed for long continued operation.

In passing it is of interest to note that most of the work involved in erecting and equipping the new foundry was done by company employes. The flasks were designed then. The patterns were made in the pattern shop. The castings were poured in one of the pits and afterward machined in the machine shop maintained on the premises. A considerable part of the equipment is strikingly original and was carried through from the drawing board to its present operating position by men in the organization.

Use Twelve Machines

A battery of 12 spinning machines is arranged in a straight line across the building at the west end. Ample space is provided between each adjoining pair for the skids designed to support three prepared molds on their way into the machine. Of course, the machine only spins one mold at a time. The extra skid capacity is to prevent any delay. Two 5-ton cranes span the section of the building containing the spinning machines and are provided with special grabs for handling the molds. As the molds are transferred from the ramming operation to the casting machines and then on to the shakeout rack it becomes necessary to turn them through an arc of 90 degrees. This change in direction is accomplished by an ingenious device which swings the equalizer beam of the crane through an arc of 90 degrees while setting the pipe molds in place or removing them.

Since the cycle of operation is continuous and each flask completes the cycle in approximately 60 minutes a description of the process may begin conveniently at the ramming station. Two ramming stations are in opera-

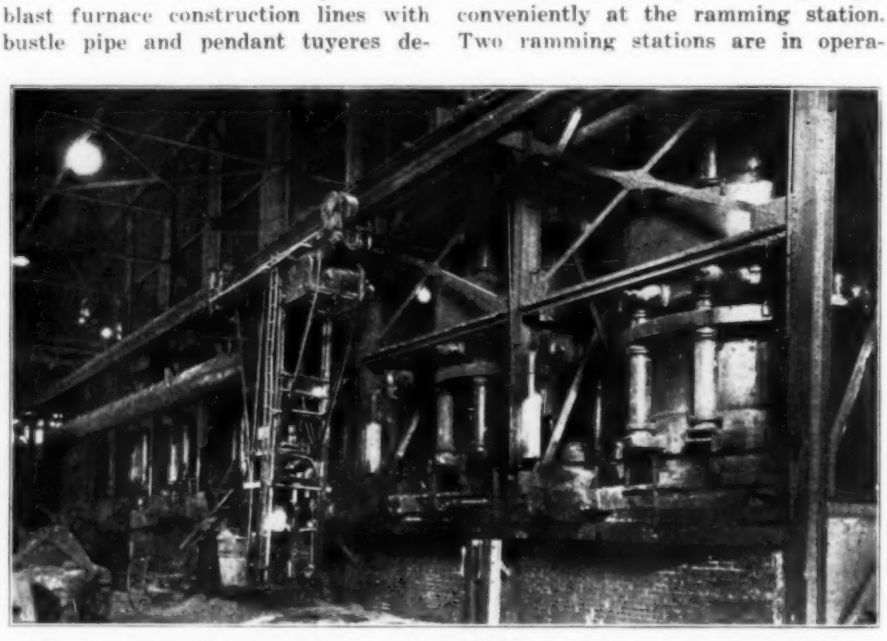


FIG. 6—A BATTERY OF SEVEN 72-INCH CUPOLAS SUPPLIES ALL THE METAL REQUIRED IN TWO ADJOINING FOUNDRIES WHERE PIPE ARE MADE

tion, but a description of one will serve for both. Each ramming station is equipped to handle six molds. One set of three molds is adjusted in place while a second set of three is being rammed.

Three empty flasks from the shakeout roll on to a hydraulically operated carriage which tips them from horizontal to a vertical position and sets them on their pedestals or revolving stools. Three long steel pattern attached to electrically-operated cables are lowered into place and center themselves in suitable sockets in the pedestals. An operator with a long handle pneumatic rammer, suspended from a light cable and counterweighted rams the sand which falls in a steady stream from an overhead revolving bin. When the sand is rammed about to the top, the operator places the bell pattern and finishes ramming. A stripper ring is clamped in place and the patterns are pulled out. A light metal cone is inserted and a bucket of wet blacking or facing is spilled into the mold. The cone distributes the blacking which flows down over the face of the sand in the mold. The tilting carriage removes the rammed molds, replaces them with a set of empty flasks and the operation is repeated.

Green Sand Molds

The rammed molds are rolled on to a long skidway where the flame from a gas torch imparts a slight skin drying from each end. Then they are lifted by the crane, swung through an arc of 90 degrees and placed on the manipulator which feeds them one at a time in the casting machine.

One of the most extraordinary features of this process, from the average foundryman's viewpoint is that metal is poured successfully while the blacking on the face of the mold is decidedly damp. Accurately machined bearings on the flask rest on rollers in the machine. The hood catches the water spray and deflects it into the open base of the machine. The hood is raised and lowered hydraulically for the insertion and extraction of the mold.

FIG. 7—PIPES ARE MOLDED, DRIED, CORED AND CAST IN A CIRCULAR PIT AND THEN SHAKEN OUT ON THE DEVICE SHOWN TO THE LEFT

An accurately weighed quantity of iron is poured into a basin outside the spigot end of the mold. A steel bar attached to the bottom of the basin tips it automatically as the hood sinks into place. The bell end of the pipe is formed by a socket core and plate clamped in place before pouring commences.

Each mold is revolved by a variable speed motor. The number of revolutions varies from 500 to 1500 per minute, depending on the size of the pipe. In approximately 30 minutes after casting the mold is placed on a shakeout machine which holds it at an angle of 45 degrees over a pit where the sand lining is removed by an electrically driven hollow augur in about 10 seconds. The sand falls into a bin and thence on to a reciprocating conveyor in the basement. The flask in returned to a horizontal position and the pipe is removed by an internal grab attached to a pulling device. The flask is returned to the ramming station and the pipe passes to the cooling skidway on the lower level where it is inspected, ground on the interior and then reheated slightly before it is dipped into the tar vat. After the coating has dried, the pipe is tested with water at 500 lbs pressure, weighed, and then stacked on the yard for shipment.

Handling the Sand

The sand is reconditioned and distributed through an elaborate sand handing system. A coarse sand with a high silica content, moisture 6 to 8 per cent, and permeability of 400 to 500 according to American Foundrymen's Association standards is employed. The necessary bond is applied through the addition of claywash.

A reciprocating conveyor discharges the hot sand into the boot of an elevator which in turn discharges into a revolving screen which removes lumps and foreign material and deposits the sand into the dry sand

FIG. 8—SPECIAL IRON MOLDS ARE PROVIDED FOR THE FORMATION OF CORE IRONS REQUIRED IN THE FITTINGS SHOP. ODD AND SPECIAL SHAPES ARE MADE WITH DRY SAND CORES

FIG. 9—WHERE THE IRON FROM THE SPECIAL SMALL CUPOLA SHOWN IN FIG. 2 IS POURED INTO TEST BAR MOLDS

storage bin. The sand is taken from this bin in batches of two cubic yards and delivered into a double cone type concrete mixer where the additions of clay wash and new sand are made. It is then delivered into a large revolving tempered sand storage bin. This bin discharges the sand through the revolving plate bottom upon belts which carry the sand to small revolving bins over the molding stations. This system is continuous and by the time the sand is discharged into the molds it is in excellent working condition. Tests for permeability, moisture, bond and fineness are taken at 15-minute intervals throughout the 24 hours to maintain the standards required.

Cupolas are charged mechanically. The loaded pans are lifted by an overhead crane, placed on a specially designed charging machine which is manipulated by the crane operator to obtain a uniform placing of the stock in the cupola. No attendants are required on the charging floor as the crane operator takes care of the entire operation, with one man on the ground as a hook-up man. One man on the crane, one man on the ground and one man on the coke will take care of three cupolas melting simultaneously and at the rate of 75 tons per hour.

Through the courtesy of the American Cast Iron Pipe Co., a description of a great deal of this work and equipment has been presented in THE FOUNDRY.

This is the fourth of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early future issues of The Foundry. —The Editors.

William W. Coleman, chairman and president of the Bucyrus-Erie Co., South Milwaukee, Wis., has been elected a director of the American Brake Shoe & Foundry Co., New York.

Readers Comment

TO THE EDITOR:

Ever since I saw the article that began on page 98 of the March 1st issue of THE FOUNDRY, I have intended to write you regarding a number of the pictures that illustrate the first of the series of interesting descriptions of the cast iron pipe industry in the South.

An illustration at the bottom of page 100 of the issue mentioned is of particular interest to me because it shows the foundry where I was first employed. That was in 1893, when I was an inspector for Robt. W. Hunt & Co., and 19 years old—rather young for such a responsibility. My first inspection job at the Chattanooga foundry, then operated by Giles, Isbester and Llewellyn, whom I remember very well, was on water pipe for the city of Chicago.

I knew personally every man whose likeness is shown in the illustration at the bottom of page 103 of the March 1 issue. This picture shows the first 72-inch pipe cast in the United States. Incidentally these were made for sewer use, not for supplying water.

John Thompson, whose picture is shown in the illustration, later became the first general superintendent of what is now the East St. Louis plant of the American Steel Foundries. As a friend of Thompson, I followed him from the cast iron pipe business in Alabama into the steel foundry business. Thompson induced me in 1900 to take up steel foundry work, a decision I have never regretted.

I am sending you enclosed a photograph taken, as I recall it, in 1899. You will find some explanations on the back of the picture. I wonder how many old timers there are like me, whose recollections have been revived by the series of articles you are presenting on the cast iron pipe industry in the South.

R. A. BULL

541 Diversey Parkway,
Chicago.

EDITORS NOTE:

Notation on the back of the picture to which Major Bull refers includes the two legends painted on the pipes and a memorandum. The legends read: Inspected by Robert W. Hunt & Co., Chicago, Ill., U. S. A., Bull—Test, and, 25 Carloads for City of Mexico, Made by American Pipe & Foundry Co., Bessemer, Ala., U. S. A.

The memorandum follows: Photo taken as I remember in 1899. From left to right, Bull, Boots, Dennis and Wright. The three last named being in the employ of the foundry.

Larger pipe, 42-inch diameter, smaller ones on top 30-inch diameter, supplied under exacting specifications on very large contract for thousands of pieces of each size for a drainage project for city of Mexico that was originally planned by Montezuma, attempted again after a fashion by the Spaniards under Cortez, but not completed until the Twentieth century.

PART OF A SHIPMENT OF 42-INCH AND 30-INCH PIPE MADE IN BESSEMER, ALA., IN 1899 AND DESTINED FOR THE COMPLETION OF DRAINAGE PROJECT IN THE CITY OF MEXICO

The FOUNDRY Family Photograph Album

Upper Left

W. H. MANTZ
Atlas Foundry Co.,
Irvington, N. J.

Upper Right

H. C. ELLIOTT
Alpha-Lux Co. Inc.,
New York

Lower Left

W. H. WORRILOW
Lebanon Steel
Foundry, Lebanon,
Pa.

Lower Right

ORTON L. PRIME
Prime Mfg. Co.,
Milwaukee

MONEL METAL AND NICKEL FOUNDRY PRACTICE

By E. S. Wheeler

Successful production of castings of monel metal and nickel requires careful attention to molding practice, proper melting equipment and the application of a definite deoxidizing and desulphurizing treatment. The numerous troubles encountered by foundries in their initial attempts to produce satisfactory castings are due to the lack of appreciation of these essential factors. The methods described in this article are used by The International Nickel Co. Inc., Bayonne, N. J., and are the result of experience gained during the past 20 years.

The shrinkage of both monel metal and nickel is ¼ inch to the foot; roughly, twice that of cast iron. This high shrinkage, in conjunction with tenderness slightly below the solidus, characteristic of these metals, necessitates special attention to insure adequate feeding of the casting and special precautions in molding to avoid the production of shrinkage cavities and pulls. The tendency of these metals during melting to absorb gases which later tend to be evolved on solidification renders the problem of the production of sound castings more difficult.

The high pouring temperature required demands the use of a refractory sand, which does not cut or wash away during pouring and thereby become trapped within the casting. Many foundries adequately equipped for melting brass or bronze have made unprofitable attempts to produce castings of monel metal or nickel and usually blame the metal for their failures, whereas the real fault lies in the inadequacy of their equipment.

The chemical compositions of monel metal and nickel castings should closely approximate those given in the accompanying table.

Manganese is detrimental because it makes the metal sluggish, so that the latter often fails to fill the mold sharply; in addition, it causes the metal to cut the sand, and adds to the susceptibility of the casting to develop pulls or tears.

Sulphur tends to cause the metal to become hot short and in addition renders it brittle at normal temperatures. The behavior of sulphur in monel metal and nickel has been studied by Merica and Waltenberg in bureau of standards, *Technical Paper* No. 281. It forms the compound Ni_3S_2, which forms a eutectic with nickel that melts at about 630 degrees Cent. and is brittle at normal temperatures. Sulphur in the presence of manganese, and particularly magnesium, forms less harmful compounds, but in any case the limit of 0.03 per cent sulphur should not be exceeded.

Silicon, in reasonable quantities, is decidedly beneficial to castings of both

Abstracted from a paper presented at the February, 1930 meeting of the American Institute of Mining and Metallurgical Engineers.

(*Continued on Data Sheet No.* 820)

MONEL METAL AND NICKEL FOUNDRY PRACTICE

(*Continued from Data Sheet No.* 819)

monel metal and nickel, because it increases the fluidity of the metal and helps it to fill the mold sharply; also because it reduces the tendency of the metal to cut the sand and partly deoxidizes the alloy. The addition of silicon also increases the physical properties of the resulting casting. A silicon content of 1.50 per cent is satisfactory for a wide variety of castings. Castings involving a thin web connecting two heavy sections, as in a wheel with a heavy hub and rim connected by thin spokes, are preferably made with a silicon content as low as 0.75 per cent, to avoid the possibility of the development of cracks in the thin section. Heavy castings may be made of metal containing as much as 2 per cent silicon.

The addition of a small amount of magnesium is necessary to deoxidize and desulphurize the metal prior to pouring. The methods for introducing the requisite amount of this metal are discussed later under *Melting*.

The natural corrosion resistance of monel metal in the form of castings is lowered if shrinkage cavities, porosity or foreign inclusions are present.

APPROXIMATE REQUIREMENT FOR CASTINGS

	Nickel, Per Cent	Copper, Per Cent	Iron, Per Cent	Silicon, Per Cent	Carbon, Per Cent	Manganese, Per Cent	Sulphur, Per Cent
Monel Metal	67	28	Under 3.5	0.75-2.0a	0.15-0.25	Under 0.50	0.03b
Nickel	Balance	....	Under 2.0	0.75-2.0a	0.15-0.25	Under 0.50	0.03b

a Depending on the nature of the casting. b Preferably as low as possible.

Many cases are on record where the corrosion resistance of monel metal castings has been unsatisfactory entirely because of inferior casting practice employed in foundries not fully conversant with the technique required for producing sound castings of this alloy.

The excellent physical properties of cast monel metal are evident from the following typical values: Yield point, 35,000 to 40,000 pounds per square inch; ultimate strength, 65,000 to 80,000 pounds per square inch; elongation, 25 to 35 per cent.

The physical properties of monel metal castings made of metal melted in a basic-lined electric furnace tend to be slightly higher than those of similar metal melted in neutral or acid-lined electric furnaces or crucibles.

Molding of monel metal and nickel castings is similar to that of steel, though no general rule can be given. Risers and sink heads should be placed so that they will feed the casting well and prevent shrinkage cavities. These risers should be placed over the sections where the greatest shrinkage occurs (the heavier ones) and should be large enough to fill these

(*Continued on Data Sheet No.* 821)

THE FOUNDRY DATA SHEET, JULY 1, 1930

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Sharp Sand Has No Bond

What is meant by the term sharp sand which occasionally I see in THE FOUNDRY? Is it what generally is known as builder's sand? Are there any specifications covering the foundry variety. What is the analysis? I should also like to have a good dry sand mixture for molding motorcycle cylinders.

ANSWER

Like many other terms in foundry nomenclature the origin of the word *sharp* as aplied to a sand containing no bond is lost in the mists of antiquity, but probably is based on the fact that sand of this character was used freely at one time for scouring and sharpening metal utensils, tools, implements and weapons. In various localities foundrymen refer to this sand as sharp sand, beach sand, sea sand, lake sand, river sand and core sand. In some places the term builder's sand applies, since the sand for building operation and sand for the foundries in the vicinity are secured from the same sand pit. In other places the terms are not synonymous since the builders can and do employ a grade of sand that is not suitable for making cores. Sharp sand as the term is used in the foundry means any clean, free running sand containing no bond, usually white or nearly white in a dry state and a sand in which the silica content is over 90 per cent. The size of the grains in various deposits range between those that are held on an 8-mesh sieve and those that will just pass through a sieve with 100 meshes to the inch. In your district the sharp sand employed in the foundry core room is derived from the sand dunes in the vicinity of the lakes. It is particularly well adapted in chemical and physical structure for making fine and intricate cores. Mixed with an oil binder in the proportion of one part of oil to approximately 50 parts of sand this material makes satisfactory molds for motorcycle cylinders or other intricate castings of that character in which the vanes present a nice problem in securing adequate strength with free venting properties in the sand.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Wants Waterproof Paint

QUESTION

Some time ago we read an article to the effect that in some pattern shops, lacquer now is employed instead of shellac to cover the patterns. The claim was made that the lacquer rendered the patterns waterproof and therefore prevented them from warping. Can you give us any information on this subject.

ANSWER

For many years shellac has been the universal material employed by patternmakers for imparting a smooth, finished surface to wood patterns and to render them reasonably waterproof. It is prepared easily for patternshop use by dissolving any required quantity in alcohol. It makes and holds coloring pigments readily, yellow ochre, vermillion or lampblack the three colors that in various combinations have come to be regarded as standard in all foundries. Thus patterns for iron castings are painted black with yellow core prints. Patterns for steel castings are painted black with red core prints, while patterns for brass and other nonferrous metals are painted yellow with black core prints.

The shellac of commerce, a light yellow material somewhat resembling soft chips of wood, is prepared by an elaborate series of processes from the resinous excretions of a certain insect on trees in the Far East. In the original state it is known as *lac* and is the material formerly and still used by oriental workmen in doing lacquer work. Naturally the supply is limited and this coupled with the enormous demand, particularly in the automobile industry, has resulted in the development of an artificial lacquer made by various companies and known under various trade names. This form of lacquer has so dominated the field in recent years that comparatively few people know of the other or know why it is known as lacquer. The new product is derived from cotton and belongs to the same family as guncotton, and celluloid. It is mixed with a quick drying solvent and presents practically all the characteristics of the natural product formerly imported from the Far East.

This modern lacquer is put up in cans ready for use. On account of its quick drying properties it is applied, especially over large surfaces, with a spray gun.

The proprietor of a prominent pattern shop supply house informs us that several large pattern shops now are using this modern lacquer on all patterns that formerly were covered with shellac. This is particularly true of patterns subjected to hard and constant service. At current market prices, lacquer costs approximately twice as much as shellac bulk for bulk. We have no figures up to the present to show the comparative worth of the two materials as a covering for patterns. The value of shellac as

a covering medium is increased in many instances by the addition of aluminum powder. The powder is mixed with the shellac-alcohol combination and the material is aplied to the pattern in the usual manner with a brush. It is claimed that the powder constitutes a thin metallic film which greatly protects the surface.

Seeking further light on the subject we are informed by a prominent paint manufacturer that he has a certain paint superior to either shellac or lacquer as a water proof material. It is derived from pine tar and is used extensively for many purposes where resistance to the penetration of water is a necessary factor. He admitted that up to the present this paint had not invaded the patternmaking field, but he expected a development in that direction after the paint became known and as soon as his salesmen found it necessary to develop the market intensively. At present the outlets were beyond the factory capacity.

Q & A

Sand Sticks to Pattern

QUESTION

We use cold sand, the best grade parting compound and the best shellac, but the sand sticks to the pattern. Our local paint man claims that the alcohol contains a large percentage of kerosene and that is the cause of the trouble. Can you advise us how to overcome this.

ANSWER

If you are using grain alcohol it is possible that it contains kerosene oil, although other and more obnoxious materials have been used in the mixture to discourage its use as a beverage. Wood alcohol is sufficiently poisonous in itself, therefore no adulterant is necessary. To test out the theory that the kerosene oil is responsible, you might secure a small amount of wood alcohol, mix a special batch of shellac and try it on a pattern. Frankly, we do not think kerosene oil is responsible for your trouble. In many foundries the practice obtains of sprinkling the pattern with kerosene oil, or of coating it slightly for the express purpose of preventing the sand from sticking.

If the alcohol through any ingredient added to it directly or indirectly is responsible for your trouble, the obvious remedy is to abandon its use and employ wood alcohol for mixing your shellac. A coat of the new shellac over the paint on the existing patterns also should render them immune to dampness. Before definitely placing all the blame on the shellac, examine the patterns and sand. Metal patterns have a trick of condensing moisture on hot days and sometimes careless molders work their sand a little damper than necessary.

GRAY IRON

Needs Better Feeding

QUESTION

We are sending a piece of pig iron we use in our foundry. You will notice that the center of this pig is black with gray edges and to us looks entirely different from the usual run of pig iron which shows a uniform gray color all the way through. This pig iron contains 2.5 per cent silicon; sulphur, 0.03 per cent; phosphorus. 0.4 to 0.5 per cent and manganese. 0.8 to 0.9 per cent. We are using 35 per cent of this pig with No. 1 machinery scrap, and our own return scrap. We also are adding borings from our machine shop. These are placed in sheet iron cans about the size of a stovepipe with cast iron ends closed tightly.

We manufacture waterworks valves and some of the valves of heavier section show a slight seepage in one place just above the gate on some runs. On breaking these valves, they show shrinkage or open porous iron at this point. We had considerable trouble with this until we checked the volume of air going into the cupola which we found to be too high. We use a cupola lined to 45 inches, with a bed 28 to 30 inches above the tuyeres, and an air volume close to 3400 cubic feet per minute at 6 ounces pressure by a mercury gage.

Do you think that the pig iron carries oxygen and may cause the shrinkage in the castings due to the fact that the freezing point of the iron is raised and the gate will not feed the castings?

ANSWER:

We doubt that the pig iron contains an appreciable amount of oxygen as the high silicon and low sulphur contents indicate a highly reducing condition in the blast furnace operation. Your troubles undoubtedly are caused by other things. The borings for example, usually induce more oxidation during cupola melting than do pig irons and regular scrap. A high silicon pig such as you use, naturally has a darker fracture than an equivalent pig of lower silicon content. This is because high silicon throws out more graphite and makes a softer, more open appearing fracture than lower silicon pig iron. This takes place up to around 3.0 or 3.5 per cent silicon. In high percentages of silicon around 7 to 15 per cent, the pig iron has a silvery fracture.

From your description it is evident that the casting is feeding the gate rather than the gate feeding the casting. Your trouble appears to be shrinkage. This indicates one of three things: Insufficient feeding or running the gate into too heavy a section; dull iron or too low a pouring temperature, and a more remote possibility—improper metal composition. We suggest that you increase the volume of metal in your gate. Increasing of gate height also may help considerably. If you do not want to increase the rate of flow of the metal into the casting, cut down the size of the gate entrance just at the point of entry by a skim gate core. Be certain that your pouring temperature is between 2400 and 2500 degrees Fahr. If these changes do not remedy the condition, try lowering the silicon for the heavier castings. In sections over 1-inch, silicon over 2.50 per cent is likely to promote shrinkage.

The addition of a small amount of steel sometimes has a beneficial effect on minimizing shrinkage. Even 5 per cent may do the trick. It may be that your air volume is a little too high. It is possible that 3000 cubic feet per minute will give a hotter and more fluid iron without reducing the melting rate appreciably. The bed height is all right unless the cupola tender burns it down below this point before commencing charging.

Q & A

Makes Semisteel

QUESTION

We are interested in making semisteel castings and will appreciate any assistance you can give us in telling how this may be accomplished in connection with our regular gray iron practice.

ANSWER

Semisteel as it commonly is called is made by the addition of steel scrap to the iron charges placed in the cupola. The amount of steel scrap added may range from 10 to 35 and even to 100 per cent in some special cases. Ordinarily the range is that given first. The amount to be used will depend upon the type of castings and the raw material at hand. In light castings, only 10 per cent steel scrap may be permissible while with heavy castings it may reach the upper limit. Steel scrap used judiciously will give strong, dense castings. Since you do not state what types of castings you wish to produce, we cannot offer any suggestions on the amount of steel scrap to bring about the desired results. However, you can experiment for your own benefit. Begin with 10 per cent and increase it until satisfactory results are obtained.

In charging the cupola, the steel scrap should be placed first and followed by the small cast scrap, heavier scrap and pig iron. Plenty of coke should be used so that the charges are melted as hot as possible. The iron to coke ratio may be from 6.5 to 7.5 to 1 with the preference for the

lower ratio. If you only want to melt a few charges containing steel scrap, they may be placed either first or last in the day's heat. If they are placed first, see that the cupola bed is from 30 to 42 inches above the top tuyeres when the iron is charged. This will give hot iron right at the start. If the steel scrap is added at the end of the day's heat place an extra coke split on the last regular charge, and then put in the special mixture. This extra weight of coke will cause a noticeable halt in melting and will indicate the end of the regular charge and the beginning of the special iron. Also in melting steel scrap it will be advisable to use a mixing ladle at the spout to insure a well-mixed, uniform iron. The mixing ladle should be large enough to contain at least one charge of molten iron. Also it is advisable to use pig iron containing over 1 per cent manganese; the higher the better. If this is not at hand use enough ferromanganese to bring the manganese content to around 0.70 per cent at the spout. The increase in manganese will assist greatly in overcoming any difficulty created by the increase in sulphur content.

Q & A

Iron Becomes Hard

QUESTION

We operate a jobbing shop making castings weighing from a fraction of a pound up to 3 tons. We are having trouble with hard iron on our small stoveplate castings. The last analysis we had on these castings showed 2.37 per cent silican; 0.048 per cent sulphur; 0.561 per cent phosphorus, and 0.70 per cent manganese. We are making the castings in Albany sand and are watching them so that they are not dumped too soon.

ANSWER

The composition generally used for stoveplate castings ranges from 2.25 to 2.75 per cent silicon; sulphur as low as possible; 0.60 to 0.90 per cent phosphorus and manganese from 0.50 to 0.80 per cent. As you can see, your present analysis runs close to the figures given with the exception of the sulphur which is 0.048 per cent This seems to be much lower than ordinarily obtained in the cupola, and may be due to an interchange of figures—the correct value being 0.084 per cent. Your hard iron may be due to several causes, such as wet sand, hard ramming, and possibly due to variations in your mixture. If you are using several different mixtures for different types of castings, the castings which come hard may be poured from the tail end of a mixture for heavier castings.

It sometimes is difficult to get a good separation of the different mixtures, and the iron between two charges varying considerably in silicon should be poured into castings wherein it will have the least effect. One method used to give a more distinct demarcation between two different mixtures is to employ an extra split of coke. This will cause slow melting at this point and indicate to the cupola operator that the mixtures are changing. You might also check up on your molding and sand condition to see that the hard iron is not caused by them. Increasing the silicon to the higher figure given will give soft iron, but we suggest that you check up all around before raising the silicon. Constant observation and checking operations will prevent much grief in the foundry.

Q & A

Gear Teeth Break

QUESTION

Can you advise me as to the most suitable quality of cast iron for use in gear wheels used on tinning machines in a tinplate mill or any change in molding methods to produce gears that will wear well and not have teeth that will snap off. The gear wheels vary from ½ to ¾-inch pitch with 1½-inch faces and contain from 15 to 40 teeth. They vary from 7 to 10 inches in diameter. The tinplate mills recently have been speeded up to conform to speeds used in the United States. I understand that some blanks cast centrifugally were used without success for these mills.

ANSWER

From the data given it appears to us that the difficulty does not come from the mixtures used or the way the gears are molded, but from the fact that the gears are not strong enough to withstand the added load resulting from speeding up the mills. Therefore, unless the gears are redesigned so that they are stronger, it may be possible that gray iron cannot be used. Blanks cast centrifugally should give a strong, dense metal at the outer edge, and should be ideal for gears. A mixture used in this country for small gears of the sizes you mention contains from 2 to 2.50 per cent silicon; below 0.35 per cent phosphorus, and 0.60 to 0.80 per cent manganese. However, as mentioned, if the teeth are not heavy enough and do not possess the proper width of face to carry the load, they will break off.

Some firms in this country are using nickel with lower silicon than that mentioned for making gears and pinions. A composition that will give you about 1.5 to 2 per cent silicon and 1.5 per cent nickel should give a stronger gear. However, we do not know whether this composition will be strong enough for the intended use.

MALLEABLE

Fracture Is Unusual

QUESTION

I am enclosing a small section broken from an annealed malleable casting and would like to know what the fracture indicates as it differs considerably from the regular blackheart fracture. It has a light gray skin with a bright steely appearing interior. The piece has been broken off although it looks as though it was sheared. The analysis is approximately as follows: Silicon, 0.87 per cent; sulphur, 0.086 per cent; manganese, 0.32 per cent, and total carbon 2.90 per cent. The mixture used contained 47 per cent pig iron; 3 per cent steel rails; 8 per cent annealed scrap, and 42 per cent hard iron scrap. The annealing temperature was approximately 1650 degrees Fahr.

Is it good practice to add steel to the mixture after the charge is melted down—say a few hundred pounds of steel rails if the tests show that the iron is too soft? The bath is thoroughly puddled after the steel has been added. Is there any danger of the steel segregating? How long should the heat be held after adding the steel?

ANSWER

The analysis that you give is somewhat high in carbon and silicon. The manganese-sulphur ratio is not to be criticized. Phosphorus is not reported but for the silicon shown, should not be much above 0.16 per cent. The mixture seems to be all right and the addition of steel to molten iron is good practice. We do not think that with any ordinary precaution the steel will not be mixed completely. Fifteen minutes with rabbling should be ample. Indeed with rabbling the time will depend more on the need of reheating than anything else.

Microscopic investigation would disclose whether the metal is annealed completely. The fact that the surface of the specimen is cut up badly under the hammer suggests complete anneal, but does not prove it. Possibly the metal suffers from intergranular embrittlement which may originate from high annealing temperature, high silicon, high phosphorus and a long exposure to a temperature near 900 degrees Fahr. You might investigate the intergranular brittleness question by heating a regularly annealed specimen to 1200 or 1250 degrees Fahr. and quenching in water. This should produce a normal fracture if that is the fault.

If the fault is as suspected and it is not expedient to change the composition or annealing conditions, a proprietary process of heat treatment employing temperatures from 1200 to 1250 degrees Fahr. and water quenching, may yield results.

Problems in Nonferrous Founding

By Charles Vickers

Melting Is Slow

We are making ring castings of an alloy of 83.81 *per cent copper;* 10.74 *per cent tin;* 2.20 *per cent lead;* 2.69 *per cent zinc;* 0.51 *per cent iron, and* 0.03 *per cent phosphorus. We make this from half scrap and half new metal with the addition of* 4 *pounds of phosphor-tin in* 250 *pounds of the metal added just before pouring. The metal is melted under charcoal in coke-fired pit furnaces, but the draft is poor. It usually takes* 5 *hours to get the metal hot enough to pour. Under the microscope this metal shows what appear to be oxides. We add phosphor-tin as a deoxidizer but the metal may be so badly oxidized that the oxides are not entirely removed.*

The great fault is the length of time that is required to melt the metal. A pot of 200 pounds of metal of the composition given should be melted in from 35 minutes to an hour, depending upon the state of the furnace. That is, if the heat went into the furnace immediately after a previous heat had been pulled and poured, it would come out in 35 minutes at a temperature of 2300 degrees Fahr., and such metal will make sound castings. If the furnace had cooled, the heat would take 45 minutes. Starting with a cold furnace, one hour will be required to melt to pouring temperature. These data are from an oil-fired crucible furnace. With the pit-furnaces mentioned, it takes five times as long.

A coke-fired furnace though, with proper draft will do much better than 5 hours to a heat. A No. 100 pot ought to come out in 3 hours with natural draft, and with from 1½ to 2 hours with forced draft. Probably the easiest way would be to close the ashpit and put a blast under the fires. What is needed is a soft blast, such as given by a fan, the pressure being a few ounces, and not a few pounds. While the melting part of the process should be altered, an inspection of the sample cut from the casting gives us the idea that the metal has blown from the cope, as all surfaces are sound, except next the cope. The cope, then must have been rammed too hard, or too much clay wash was used on the gaggers. A core used to make a groove such as shown in the section of the casting, has to be made of a free open sand, or else it must be thoroughly vented.

The sand seems to contain lime. If it is a natural sand, this lime is carbonate of calcium and not the oxide. Carbonate of calcium gives off carbonic acid when heated to a red color, so if this diagnosis is correct, these specks of carbonate in the sand might be responsible for the gas holes in the metal.

Q & A

Segregation Occurs

We are making a high lead alloy with which we have trouble. We are unable to describe the condition so we send two samples in which you will note certain defects.

The defects are known as copper spots, a name that will serve to identify the defects for foundrymen. They appear to be caused by the migration of some constituent of the alloy to some more favorably situated part of the casting. This will naturally be from a higher level to a lower one. In the case of car journal bearings cast back up, we find when the brass is fractured, a copper spot in the middle portion of the back, which condemns the castings. Some people put a chill along the bearing and claim that this stops the segregation. This trouble may be exaggerated by the use of certain fluxes commonly used by founders of high lead alloys. It is advisable to restrict the amount of flux used to as little as will produce the result desired. Especially it is desirable to limit the use of sulphur or salts carrying this element. Plaster of paris seems to be an exception as the sulphur is held firmly.

High lead alloys in which the lead content does not exceed 30 per cent, require no flux other than the usual covering over the metal to guard against excessive oxidation. We are unable to give any definite advice in regard to the samples submitted, as all the information in regard to them has to be gathered by looking at the castings.

Q & A

Changes Metal Additions

We are duplicating some of our patterns in an alloy of 87 *per cent zinc;* 10 *per cent copper; and* 3 *per cent tin, which, we find is a good nonshrink metal. However, it appears to be too brittle for large patterns. In melting we melt the copper first, then add half the zinc in the furnace, the balance outside. Is this good practice and is there a better mixture?*

It requires about 10 per cent copper to break up the crystals of zinc and make the beginnings of an alloy. The addition of tin fails to materially strengthen the alloy, so for thin large castings it is rather too brittle. The alloy strength can be increased materially by adding aluminum, but then it ceases to be what is here called a nonshrink alloy. Thus an alloy of 85 per cent zinc; 10 per cent copper and 5 per cent aluminum would be plenty strong enough for the patterns in question, but it might shrink too much. It might be better to use an alloy of 58½ per cent tin; 22 per cent zinc; 12½ per cent lead, and 7 per cent antimony, which is a well known low-shrink alloy, suitable for pattern duplication.

You are not making the alloy correctly, while there are several ways that give equally good results we prefer first to melt half of the zinc part of the charge and add the copper as thin strips of rolled copper. The zinc is made hot almost to the flaring point when it will dissolve the copper. When the copper has dissolved, make further additions of zinc to keep down the temperature. Before adding the tin, deoxidize with a small piece of thin aluminum foil (not tin foil) about 2 inches square, stir in the foil, just enough to give a silvery appearance to the alloy, and finally add the tin. In every case of the alloy given as a substitute first melt the lead, then dissolve therein the antimony, next the zinc, finally the tin.

Fundamentals of
FOUNDRY PRACTICE

Refractoriness Is One of the Most Important Features in Any Sand Designed To Be Used in a Core

By Ivan Lamoureux

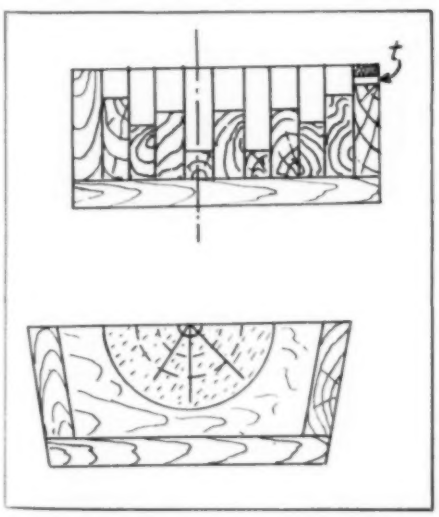
[Interpreted in the Light of American Practice by Pat Dwyer]

Part XIII

A CORE should be able to withstand contact with the melted iron without damage. This quality is imparted to it especially by the silica of the sand. Core sands should contain little lime, oxide of iron or magnesia. The size of the grain depends on the size of the core to be made and the purpose for which the core is intended and its use.

A core should be capable of being carried around and lifted without breaking. It should withstand the static pressure exerted upon it by the metal in the mold which at times is high, and also the pressures due to the differences in density. Every body immersed in a liquid is subject to an upward force equal to the weight of the displaced liquid. The core should be capable of being used without a core-frame or arbor in every case where the placing of the latter is too difficult or too tedious. A good core sand should be plastic. It should not crumble before being dried.

It may be conceded as a principle that the less gas a core releases at the time of pouring, the less trouble will be experienced from the standpoint of the metal. Thus for example, the splitting cores of pulleys and other wheels, cylinder jacket cores, cores over which metal is poured flat, bushing cores, etc., are brought to a red heat when they are made with fat sand, such as loam semifat molding sand, weak sand and mortar sand.



FIGS. 163 AND 164—LONGITUDINAL AND CROSS SECTION OF BEARING COREBOX

Core Shop Practice

VARIOUS sands may be employed in core making practice and various materials may be incorporated in the sand to serve as binding agents to hold the sand grains together after the cores have been dried or baked. Selection of the proper sand and binder depends on many local conditions including the shape and size of the core, the character of the available sands, relative costs of sands and binders. Typical sand mixtures are presented for various classifications of cores and directions are given in detail for making typical cores.

In cores made up with silicious sand, that is sands with no plasticity, or bonding power, a large volume of gases will be developed at the time of pouring. These gases come from the artificial binders mixed with the sand, flour, molasses, linseed oil, dextrine, rosin, etc. However in general these products are consumed quickly.

A good core should be readily removable from the casting, so as to reduce to a minimum the cleaning cost. As a general rule a core easy to remove is satisfactory in every other respect. A core which has to be removed by chisel and hammer is evidence of poor core making practice either in materials or methods, or both. Sometimes, especially in thin castings, the risk is incurred of breaking the casting while trying to remove one of these hard cores. A core should be sufficiently fragile to compress under the shrinkage force of the metal. If the iron in a thin section is not able to crush the core, it will break.

The core irons should be placed at some distance from the face of the core so as not to prevent contraction. For this same reason, in some special cases, the inside of the core is made of pieces of coke or slag. In other instances large openings are formed in the core before it is dried. Later these openings are filled with sand which is not rammed.

When the ramming of a core is completed in an open top corebox, a joint has to be made. The sand is stricken off with a steel strip or a wood straight edge. Then the core is taken out of the box, or the core and corebox are rolled over on a plate, where the corebox is removed and the core remains. The outside of a core should not be slicked with the trowel as it needlessly hardens the surface and prevents gas escaping, also the surface is made uneven, right where it should be perfectly even. Drying cores reduces their

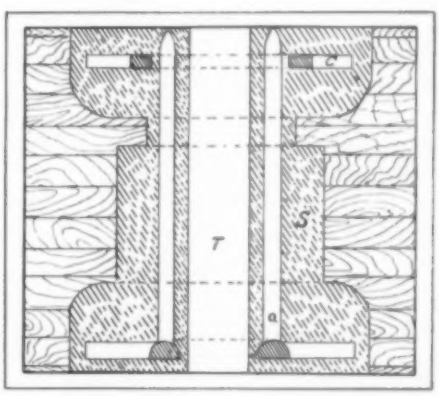


FIG. 165—APPLICATION OF THE DOUBLE ARBOR SHOWN IN PLAN IN FIG. 166

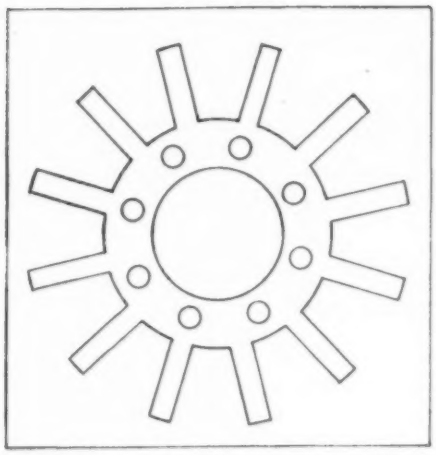


FIG. 166—IRON ARBOR IS CAST EITHER WITH STEEL RODS IN PLACE OR WITH OPENINGS TO FIT OVER THE RODS IN A SECOND CASTING

volume. In cores made of clayey sand it also causes cracks.

The silicious sands never should be dried beyond 400 degrees Fahr. All the binders will be burned out at 575 degrees. Silicious sand which is highly refractory, is used widely in making cores of small cross-section. As this sand has no cohesion of its own, it has to be mixed with certain binders to be described later, which give it the required plasticity and strength to hold its shape in the green state and to resist the pressure of the molten metal after it has been dried and placed in the mold. Fat sand or medium fat sand, that is a heavily bonded natural sand, is not suitable for cores. Of course, it can be manipulated quite readily but cracks develop all over the surface during the drying period and cores made from this sand are difficult to remove.

In mixing a certain quantity of fat sand, old sand and sharp sand, together with manure and tan bark, an extremely fat and plastic sand is obtained for making large cores. The proportion of tan bark put into the composition of the sand should be quite large, to facilitate the shrinkage of the metal and the removal of the core. Manure and tan bark are not used in American foundry practice. Coarse, natural bonded sands are employed for large cores, a carefully calculated amount of artificial binder burns out at the time of pouring and facilitates the removal of the sand afterward.

As a general rule, mixing sands of different size grains is not advisable. However, to secure a strong core of silicious sand, a core which will not crumble, or sag before drying, molding sand may be added in the proportion of one part to 3 to 4 parts silica sand.

This fat sand supplies clay to the silicious sand and consequently gives it the body, binder and plasticity required. A slight amount of molasses added to this mixture gives a product which easily is worked and gives good results. Flour mixed with silicious sand gives it plasticity. The mixture is suitable for average size cores and preserves well the shapes it is desired to obtain. The usual proportion is one part flour to 10 parts sand. Flour rarely is employed alone. Usually the sand is wet down with a water soluble binder. Other binders also are employed in connection with flour.

Pure raw linseed oil probably is the best of the many binders used in foundries. It is used especially in machine core-making, where the uniform sliding of the sand into the tubes plays an important part in the proper operation of the machine. Various proprietary core oils in which linseed oil is the base, have taken the place of the oil by itself.

Makes Core Resistant

Linseed oil and its various substitutes make the core extremely resistant after the drying. Drying should turn a core prepared with linseed oil to a black or dark brown color; but the drying should be discontinued as soon as this tint is reached, otherwise its binding power would be destroyed. With the prepared oils the cores are dried to a color between yellow and brown.

Of all the binders, molasses usually is the cheapest. Diluted in water in the proportion of 1 to 10 or 1 to 15 it gives resistant cores after drying. Cores made from this combination should turn to a light brown color in the oven.

Rosin is an aglutinant or binder whose effect is not evident until after the core has been dried. With rosin in the mixture the drying of the core should not be too violent.

There are any number of binders on the market under a variety of names, and all will serve satisfactorily if employed with knowledge and discretion. They may be divided into four main classes: Oil binders, water soluble binders, binders with a dextrine base and those with a pitch base. A test should be made to determine which binder or binders should be used under a given set of conditions to give better results from the point of view of strength, porosity, etc., of the core, to reduce labor and other costs.

Several American foundries now are using cement as a core binder. The cores are not dried in an oven, but are allowed to air dry for one or two days before being placed in the molds.

Coarse salt sometimes is employed advantageously in average size cores, to which it imparts pliancy after drying. Salt in very small cores where it is not consumed entirely, causes the formation of a hard mass which is almost impossible to remove also, it should be noted that at the time of pouring, the salt used as a core binder develops very disagreeable gases.

The following mixtures are satisfactory for various classes of cores:

Small and medium size cores:

1—Silicious sand, dry, 50 parts; linseed oil, 1 part; molasses 5 parts.

2—Silicious sand, dry, 50 parts; flour 2 parts; rosin, 2 parts. Moisten with pure water or additions of molasses.

3—Silicious sand, dry, 80 parts; flour 5 parts; linseed oil 4 parts; molasses 3 parts. Especially suitable for machine work.

Medium size core mixtures follow:

1—Coarse molding sand, dry screened, then wetted. These cores should be thoroughly baked and blacked.

2—Silicious sand, 50 parts; dry fat sand 10 parts; molasses 2 parts.

The following mixtures are suitable for large cores:

1—Fat sand, dried and screened, 1 part; old sand dried and screened 2 to 3 parts. Wet rub and mix thoroughly.

2—Weak sand, 3 parts; Manure, tan bark or linseed oil 1 part. Wet to a mortar state.

The mixture for the cores is composed of 2 or 3 parts of the first composition and 1 part of the second, thoroughly mixed.

To prepare the sand required for making bushing cores, it is necessary to gather up all the loose sand around the core making stands, pass this dust through a fine screen, rubbing it with the fingers to break up the lumps and

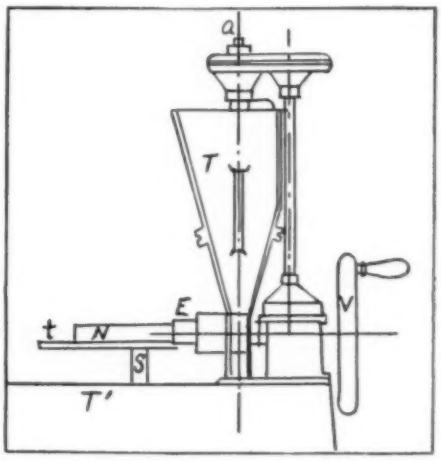


FIG. 167—CORES ARE FORMED BY FORCING SAND FROM A HOPPER THROUGH A SUITABLE DIE

manure and force it through the screen.

Make a heap of it, hollow it out and pour water into the hollow. Mix it with the fingers and knead it over carefully. When all the lumps have been crushed and no more dust is left, pass it through a sieve. The sand thus obtained will be mellow, plastic and ready for molding.

The foregoing is a distinctly foreign mixture and is not employed in American foundries where small cores are made from sharp sand bonded with any one of the various dry binders.

A typical bushing core is made in a half corebox as shown in Fig. 163 in the following manner: Place a thin layer of sand in the bottom of the box. Tamp down this sand with a suitable wood or iron tamper. Refill little by little with sand and continue tamping it down as evenly as possible. When the sand has reached to within 1-inch of the edge, stick in a small diameter rod, depending on the size of the core. This rod will serve as a reinforcement. Finish refilling with sand and hammer down with a mallet. Scrape off the excess sand with a wood or steel straight edge. In the center of the joint face of the core, cut a channel for the escape of the gases developed when the mold is filled with metal. Vent the deep portions of the core with several vents leading into the central channel as shown in Fig. 164. Place an iron plate against the face of the core, then turn the whole thing over. Jar the box with blows from the mallet, then raise it vertically. Take out one by one any loose pieces of wood composing the form of the core and replace them properly in their respective places in the box. Place the core on a car or a shelf in the oven to bake it.

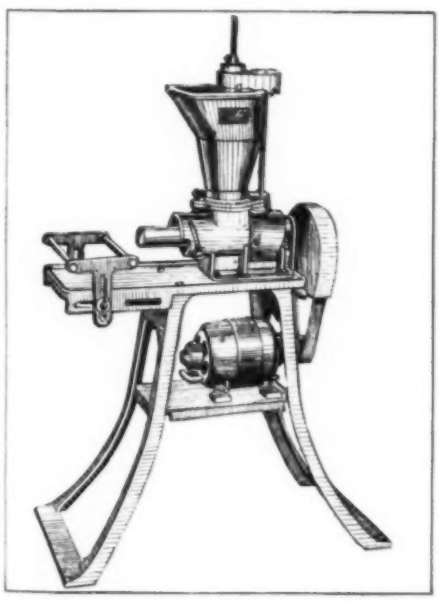


FIG. 168—MOTOR DRIVEN TYPE OF THE SAME MACHINE SHOWN IN FIG. 167

The core which has just been made represents only one half of the complete core. A second similar part is made and dried and the two parts are assembled in the following manner: Smooth up the surfaces which are going to be in contact with each other by rubbing them against a smooth plate, or against each other. Cover the faces which are going to be in contact, with a thin layer of fat sand diluted in water, with thin flour paste or with any of the proprietary pastes which are on the market. Assemble the two halves by pressing them strongly one against the other. For additional precaution sometimes one or two strands of wire are bound around the core and tightened with a pair of pliers.

Where a core is complete in itself without requiring assembly of any kind, the air channel would run considerable risk of being reached by the metal, unless steps are taken to prevent it. In a case like that, the molder should place a second rod in the core with the ends projecting through holes in the box made for the purpose.

Removing the Rod

When the core is rammed and dressed, press any kind of a small plate against the face while pulling out this vent rod. If one were to draw out the rod without pressing against the face, the surface might bulge up. Turn the core over as in the previous case and place it in the oven.

Many cores are used in the natural state without blacking, but where blacking is employed, it may be applied either before or after the cores are dried. Local conditions govern practice in this respect. Usually large cores are blacked before they are placed in the oven either with a brush or swab, or by spraying. Small cores are dipped in a vessel containing blacking after they are dried.

Core sand obtained by mixing the components in a dry state does not have the same characteristics as sand obtained by collecting and screening the core wastes. Wetting at a mortar stage probably has the effect of better spreading the alumina and silica through the sand and thus giving it a particular consistency having real qualities of plasticity, porosity and mellowness.

To make a core for a housing as shown in Fig. 165, proceed as follows: Put down a 1-inch layer of core sand. Place the clay washed core iron, Fig. 166. Put in the plug for the vent, *T*,

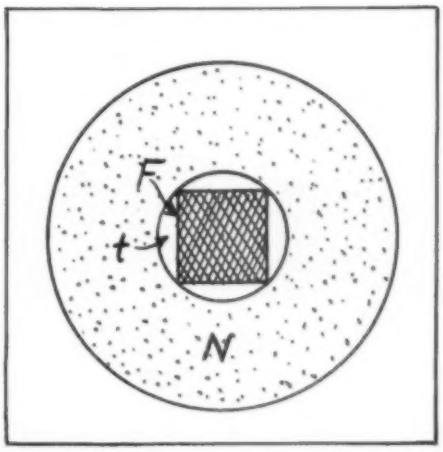


FIG. 169—A SQUARE ROD IS INSERTED IN THE VENT HOLE TO REINFORCE THE DRIED CORE

Fig. 165. Ram sand uniformly and steadily up to the top. Within 2½ inches of the top edge ram in a second or plain arbor without pins. Add more sand and ram flush with the top of the box. Remove the box and dry the core on a cast iron plate. On removal from the oven lay the core on a pile of straw, sand, or empty bags. To lift the core and lower it into the mold, put an iron bar through the vent hole in the center and hook a chain on each end of the bar.

Fig. 167 shows a core-making machine. The machine consists of a hopper forming a base with the necessary bearings for the driveshaft. On this shaft are placed: a hand wheel, a gear, and a threaded bushing. The top bracket is attached to the hopper; it supports a gear which meshes with another pinion on the vertical shaft *a*. This vertical shaft is maintained at the proper height by a collar with a pressure screw. A worm *H* and the die *E* determine the size of the core.

To operate the machine proceed as follows: Place a worm in the bushing having a number corresponding to the size of the core it is desired to make. Insert a die corresponding to the number of the worm. All the worms and dies are numbered. Fill the hopper with sand. Turn the handle at a speed of 120 to 150 turns per minute. When the core begins to come out of such consistency that it will support an overhang of a length equal to its diameter, place the corrugated sheet *t* under it. The level of this tray is regulated by the support *S*.

The height of the tray should be regulated so that the core slides into it without breaking. Having obtained a core from 20 to 24 inches, or any desired length, the tray is moved over to allow another length to land alongside of it, and so on until the tray is covered with cores. Dry the cores in

an oven in which the heat can be regulated easily. Take the cores out of the oven as soon as they turn a dark brown. If the cores are taken out of the oven while they are still yellow, the oil and flour contained in them will release a large quantity of gas during the pouring period. This gas requires a long time to escape and would cause bubbles in the castings.

If the cores are allowed to remain too long in the baking oven, they will crumble. The binders are completely consumed, and nothing remains but the silicious sand, which in itself does not carry any bond.

Machine made cores are a great convenience in the foundry due to the fact that large quantities of cores of all diameters and of great length may be kept on hand. These may be cut to any desired length. An improved type of core making machine in which an electric motor is utilized instead of a hand wheel, is shown in Fig. 168. The output of this machine is given as 10 feet per minute.

To make square faced cores, a grinding wheel with a right-angle guide is used. To make the taper fit the core print, an oblique guide is used which forms a core to any desired angle. If no grinding tool is available, the taper core print can be made by filing the core with a piece of a grinding wheel. In an emergency the core may be formed with a coarse file, but this method is not recommended as the hard core will dull the best of steel. Also hand coning never is as accurate as work done on a machine.

A long machine-made core, if necessary, may be reinforced as follows: Secure a square iron or steel rod corresponding to the diameter of the vent hole of the core. Push the rod into this vent so that the corners of the rod cut slightly into the walls of the vent as shown in Fig 169. The space left between the square rod and the round vent hole is adequate for allowing the escape of the gases.

Good results in machine made cores are obtained by using a mixture consisting of 100 parts of clean sharp sand; 12 parts of flour; 1 part of raw linseed oil. The whole is well-mixed and carefully sifted. Experience will determine the best proportions to be used according to the diameter and shape of the core. Molding sand is not all suitable. It contains too much clay. It packs into the die and is hard to remove. The same applies to old burnt molding sand. Sea sand and the white sand used in glass-making may be used satisfactorily.

Parts of core-making machine, the trays, screw, tubes, etc., should be thoroughly cleaned and greased after using them each time, to prevent the binders and the sand from forming a coating on these parts which is very hard to remove after standing for more than an hour. The hopper should not be filled too much with sand; for the small diameter cores, one or two handfuls will be plenty.

Raw linseed oil gives the best results and experience has shown that the mixture outlined in a preceding paragraph is the most satisfactory.

The machine should work easily; therefore when any increase in effort is required on the hand-wheel, it is an indication that the sand is clogging the opening of the machine.

Ohio Foundrymen Meet Near Canton

REFRACTORIES, foundry costs and the revised industrial foundry code for the state of Ohio engaged the attention of the members of the Ohio Foundries association, who attended the third sectional conference of the association at the Congress Lake club, about 14 miles north of Canton, O., Wednesday, June, 18. These sectional conferences are arranged with the general idea in mind of minimizing the distance over which members have to travel. Also with the view of bringing the members of any given district closer together for a discussion of local problems.

Following this general idea a little farther, the secretary, Robert Hoierman, announced the formation of tentative plans for a subdivision of the membership into four groups according to whether a member is engaged in the production of gray iron, malleable iron, steel or nonferrous castings.

A more active interest in the revised code of the industrial commission as applied to foundries, also a more active interest in the selection of men through whose hands the code must pass to become law, was urged by J. W. Beale, Ohio Steel Foundry Co., Lima, O., Referring to accident statistics covering a period of several years he claimed that in practically all instances the evidence showed partial and in some instances complete contributory neglect on the part of the injured party or his associates. In recent years, according to Mr. Beale, failure on the part of machinery or equipment, practically has ceased to be a factor as a cause of accidents.

The speaker emphasized the importance of the foreman in any scheme of safety installed in a plant. Many workmen are constitutionally opposed to wearing safety devices and willingly will expose themselves to danger if the foreman does not constantly insist on the observance of safety precautions. He quoted several specific instances to illustrate how employers with the best intentions are penalized on account of workmen who will not obey instructions.

Commencing with a description of clay, what it is and where it is found D. A. Williston, LeClede, Christy Co., St. Louis, presented an interesting and informative paper on the subject of refractories pertaining to the foundry industry, with particular reference to the cupola. He claimed that refractories now in use have attained a high degree of excellence and that where they do not give satisfactory service, the fault lies with the method of operating the cupola. In this connection he pointed out that a more intelligent check of operation can be secured by watching the slag hole rather than the breast, tap hole and spout. Fairly good melting practice is reflected in a consumption of 3 bricks per ton of iron. On long heats under favorable conditions the ratio of new brick to metal melted is claimed to be 1 6/10 bricks per ton of iron melted.

A. C. Denison, president Fulton Foundry & Machine Co., Cleveland, presented a paper illustrating the fallacy of depending solely on a cost system. Intelligent modification and application of any cost system is necessary to meet special and changing conditions. Different methods of figuring costs will show startling discrepancies in extreme cases. This, and several related features were taken up again at the round table discussion which followed the formal meeting. Members of the nonferrous group also held a round table meet ing after the adjournment of the regular meeting where various features of particular interest to the nonferrous industry were aired in a free and informal manner. Attention was given to the segration of lead in plastic bronzes and methods of handling aluminum bronze. Gating is an important factor in securing good results with the latter metal.

Steel Foundry Specializes *in* *Railroad Castings*

By Norman F. Hindle

Fig. 13—Risers Are Cut From Castings with Gas Under 25 Pounds Pressure

A FAIRLY large department is maintained for the manufacture of cores required for the miscellaneous castings and part of the cores used for side frames and bolsters manufactured by the Scullin Steel Co., St. Louis. That department is located southwest of the foundry building and at the west end of the open-hearth platform.

Core ovens are situated along the west wall of the department. The remainder of that division of the shop contains coremaker's benches, sand storage bins, binder storage and a sand mixer. The coremaker's benches are built in the shape of a large *U* with the sand mixer forming the bottom of the letter. Sand is prepared in a muller type mixer equipped with an elevating scoop which throws the unmixed material into the mill.

Sand is mixed in 2500-pound batches. One mixture consists of new silica sand, 80 pounds of fireclay and an amount of cereal binder depending on the use to which the cores are to be put. The second mixture includes 30 per cent new sand and 70 per cent used sand, 40 pounds of fireclay and 4 gallons of an oil binder. When the ingredients have been added and incorporated in the mix, water is added at intervals during the mixing period, which is from 5 to 8 minutes, until the moisture content is approximately 6 per cent.

After the sand has been mixed thoroughly it is dumped from the mill into a skip hoist elevator which transports it to a dump car running on a narrow gage track over the sand storage bins at the coremaker's benches. The car is pushed by hand to the bin requiring sand where its contents are dumped. The car then is returned to the skip hoist conveyor where it receives a new load. Cores are rammed with air rammers and placed on trays which in turn are placed on core racks. These racks are transported to the ovens by electric storage battery trucks. Cores are baked at temperatures between 450 and 650 degrees Fahr. in natural gas fired ovens. After the castings have been shaken from the molds they are ready for the cleaning operations. The company maintains two cleaning departments, one for the miscellaneous castings and the other for the specialties, side frames and bolsters. All loose sand is shaken from them and miscellaneous castings are transported to the annealing department in cars while the specialty castings are taken to the roughing floor where excess sand, fins and gates are removed. The castings then are hauled to the annealing department by a crane that travels on a structurally supported runway between the foundry and the specialty cleaning room.

Clean the Castings

After annealing, the side frames and bolsters are cleaned in the same building but the miscellaneous castings are again loaded into cars and transported to the miscellaneous cleaning room. The building housing the annealing and specialty cleaning departments is south and east and the miscellaneous cleaning room is west and slightly south of the foundry. The location of these shops may be seen in Fig. 12 which was presented in the June 15 issue of THE FOUNDRY on Page 47.

The building containing the miscellaneous cleaning room consists of three bays. The south bay houses the ingot department which supplies material for the rolling mill that the company operates in conjunction with the foundry departments. Six furnaces, fired with natural gas, supply the metal for the ingots.

The middle bay houses the miscellaneous cleaning department. A car type sandblast room made by the Pangborn Corp., Hagerstown, Md., is located in the northwest corner of the bay. Booths for the electric welders where minor defects are corrected are adjacent to the sandblast. The chipping department joins the latter department. All these sections are located along the north side of the bay. Grinding operations are performed at a point directly across from the shipping department.

After the castings have been annealed, they are hauled to the west end of the bay in cars. First the heads and risers are removed and the castings sandblasted. Next they are chipped and welded if necessary and then ground, finished and inspected. After those operations have been completed, they are taken to the north bay and placed on racks for final inspection by the customer's inspectors.

The north bay of the building contains the final inspection department, a storage space for active patterns that are in need of repair and the remainder of the floor space is used for other storage purposes. Crane

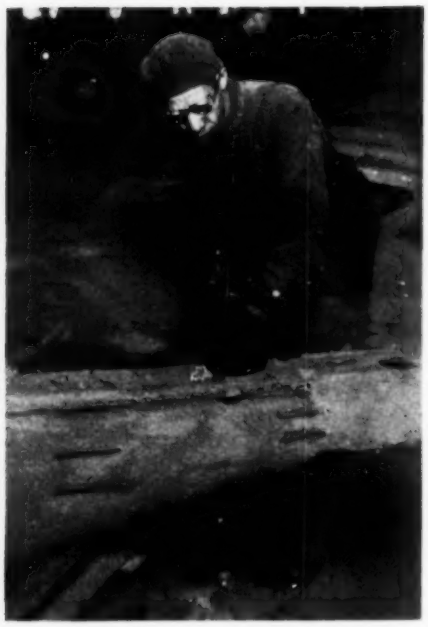


Fig. 14—Chippers Are Protected From Injury by Goggles and Hand Protectors

service in the north bay is supplied by one 5-ton crane made by the Morgan Engineering Co., Alliance, O. The middle bay is provided with two 10-ton capacity cranes made by the same company.

Gives Gas Analysis

The company is using natural gas and oxygen as a cutting medium for removing the heads and risers. The gas used recently was piped to the St. Louis district from Louisiana and is supplied by the Mississippi River Fuel Corp. It is a mixture of gases from two districts in that state in equal proportions. According to the company supplying the fuel it has the following analysis: Carbon dioxide, 0.30 per cent; oxygen, 0.20 per cent; methane, 91 per cent; ethane, 3.40 per cent; propane, 0.30 per cent, and nitrogen, 4.30 per cent. Its specific gravity is approximately 0.6 and it has a B.t.u. value of 950 to 1000 per cubic foot. According to the company supplying the gas, it has a B.t.u. value of 1000 per cubic foot when the specific gravity is 0.6. In addition to its use with oxygen to remove heads and risers, it is used in the annealing furnaces, core ovens and in all of the metal melting furnaces in the ingot and casting departments of the Scullin company.

In the removal of heads and risers, the natural gas is supplied at the torch under a pressure of 25 pounds per square inch and the oxygen at 250 pounds per square inch. The gas also is used in the annealing furnaces at a pressure of 25 pounds per square inch. A special torch is required for the cutting operation. Those in use at the Scullin Steel Co. were made by the Victor Oxy-acetylene Equipment Co., San Francisco.

The building housing the annealing department and the specialty cleaning department consists of one long bay, 660 x 85 feet, and a shorter and smaller bay 460 x 25 feet. Two annealing furnaces are located at the west end of the building. They are of the car type and fired by natural gas as previously stated. Castings are transported from the foundry in the manner previously described and are loaded onto the cars which serve the annealing furnaces. When the loading has been completed, the cars are pushed into the furnace and brought up to a temperature of 1650 degrees Fahr. in 1½ hours. The load is held at that temperature for 25 minutes and then pulled from the furnace. The furnaces are equipped with recorders and automatic temperature control devices. They anneal 800 castings per day.

Following the annealing operation, the castings are stacked at the rear of the furnaces and are removed from the pile as they are required and sent to one of four car type sandblast rooms located along the south wall of the building and made by the Titgen-Eastwood Co., Philadelphia. After that operation has been performed, the castings are taken from the cars and distributed to the long chipping rails that extend the entire length of the chipping department. The bolsters are placed on rails located at the right of the building while the side frames proceed along those at the left. A view of the department may be seen in Fig. 16. Fig. 14 shows a workman chipping a bolster.

Following the chipping operation, castings then are ready to be ground. That operation is carried out on four swing frame grinders made by the company. If the castings are slightly out of line they are pressed into shape by two large hydraulic presses, one located along the south wall of the building, for bolsters and one along the north side of the building for the side frames.

The cleaning department is well equipped with cranes having four, 5-ton capacity cranes made by the Alliance Machine Co., Alliance, O., and the small bay has two 3-ton capacity cranes made by the company. After the cleaning operations have been completed, the castings are taken to the short bay where they are mounted on rails for inspection. The cleaning room produces an average of 650 side frames per day.

Operate Pattern Shop

The Scullin Steel Co. maintains a well equipped pattern shop, 75 x 150 feet, in a building north of the miscellaneous cleaning department. Here the company manufactures and repairs all of the patterns that it uses. Patternmaker's benches are located along the north and west walls of the building. Woodworking machines equipped with individual motors and push button control, are located in the central portion and the northeast corner. A lighting system has been installed that gives an even brightness and throws no shadows. Cherry, mahogany, maple and white pine are the woods that are used in the construction of the patterns made in that shop. The latter two species are used to the greatest extent.

Since the company specializes in the production of side frames and bolsters it is logical that the majority of the work done in the pattern shop is on patterns for that type work. These patterns are constructed with white pine centers and hard maple outer surfaces. The pattern is a wooden matchplate and produces 10,000 castings or more before a new pattern is required. To maintain the shape of core prints and to insure the proper

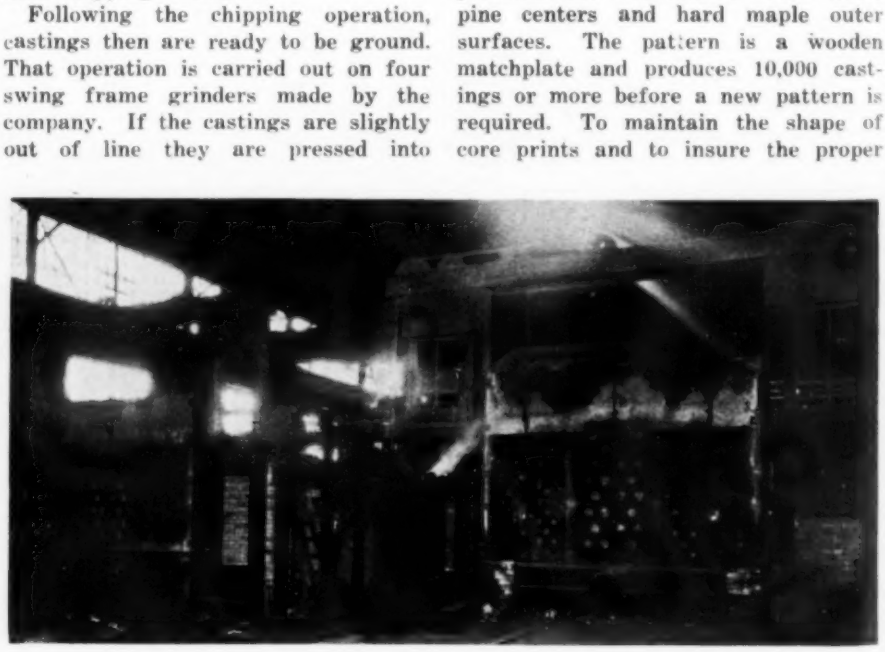


Fig. 15—All Castings Are Annealed in Two Heat Treating Furnaces Fired with Natural Gas

setting of the cores after they have been placed in the mold, ⅛-inch sheet steel is used on core prints as a protection. These pieces are fitted onto the pattern after they have been hammered into shape over a forming block.

The company does not use the usual shellac to finish its patterns. It has found that when plain shellac is used, the sand appears to have a tendency to stick to the pattern. The pattern-shop foreman has corrected that defect by adding a bronze or aluminum powder to the shellac, depending on whether it is to be used for painting the casting surfaces or core prints. The bronze paint is used as the designation for core prints and the aluminum for the casting surfaces. To make up the mixture, three pounds of shellac is dissolved in alcohol and then a pound of the bronze or aluminum powder is dissolved in three pounds of the former solution. Patterns are repainted every week.

Makes Aluminum Patterns

Patterns that are to be used over a long period of time and delicate work are cast in aluminum. First master patterns are made, then the aluminum patterns are cast and finally machined in the machine shop maintained by the company. No machining allowances are made on the patterns or the boxes. The shrinkage of the aluminum alloy from its pouring temperature is sufficient to care for that allowance.

Templates which show the contour of irregular surfaces and are used as a guide in their formation, are made from a composition pressed paper. The patterns are well fileted and drafted to facilitate easy withdrawal from the mold.

A layout is made for each pattern that comes into the shop. An office located in the midsection of the south wall of the building is used for that work and for filing templates. Layouts are made on a specially constructed table and to full size and accurate dimensions. The table is 4 x 10 feet and is equipped with a straight edge that extends the entire length of the layout board. The straight edge is of special construction. It is suspended from a shaft that is geared at each end to racks located on the ends of the table. The racks and pinions are made of brass. Brass rollers are located at three points along the straight edge equidistant from one another and slots are cut in the straight edge to allow the rollers to bear on the drawing paper. The rollers have a clearance of 1/32 inch from the surface of the drawing board. The pinions are keyed to the shaft and the rollers travel on bearings. A construction of this kind takes the weight of the straight edge off the paper.

A small "L" shaped arm equipped with a roller holds the straight edge in place and keeps the pinion meshing with rack at all times. This type of layout table is especially adaptable for large layouts but may also be utilized for small ones. One of its advantages is that once the paper has been squared with the board and the drawing commenced, straight lines always will remain parallel to the straight edge. The edge serves the same purpose as a T-square and has the advantage that it is lined up with the drawing much more easily. It also has a tendency to eliminate errors in that it is at all times square with the table while a T-square often is not square with the edge of the board. It is pushed from one position to the other with ease and may be shoved up to the top or down to the bottom of the board when sketching or other work not involving the use of a straight edge is in process on the drawing board.

Only the best lumber is used in the

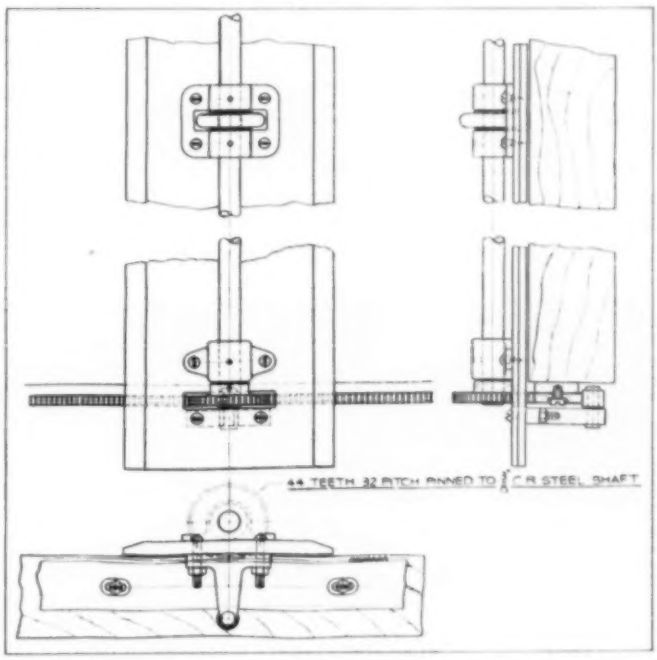


Fig. 17 — Mechanism of Straight Edge Used in the Pattern Shop for Layout Work

Fig. 16—General View of the Cleaning Room for Side Frames and Bolsters

construction of the patterns made in the shop. Grade B and better northern white pine is used and other lumber is of corresponding quality. Pattern lumber is stored in a section of the shop in the southeast corner. It is classified according to thickness and kind in a rack constructed in a pigeon hole arrangement. This method allows instant selection of lumber and in addition gives free circulation of air around the lumber.

In addition to the previously described departments, the company maintains a large machine shop, carpenter shop, power house, locomotive shop, office and a large storage yard. The Scullin Steel Co. does all of its own machine work in a building 90 x 240 feet provided for that purpose. The electrical repair and pipe shops also are located in that building. In addition to the necessary machining on the company's own work, this department repairs the equipment throughout the plant including cranes, ladles, etc. A locomotive repair shop is maintained for any repairs necessary to the five engines owned by the company.

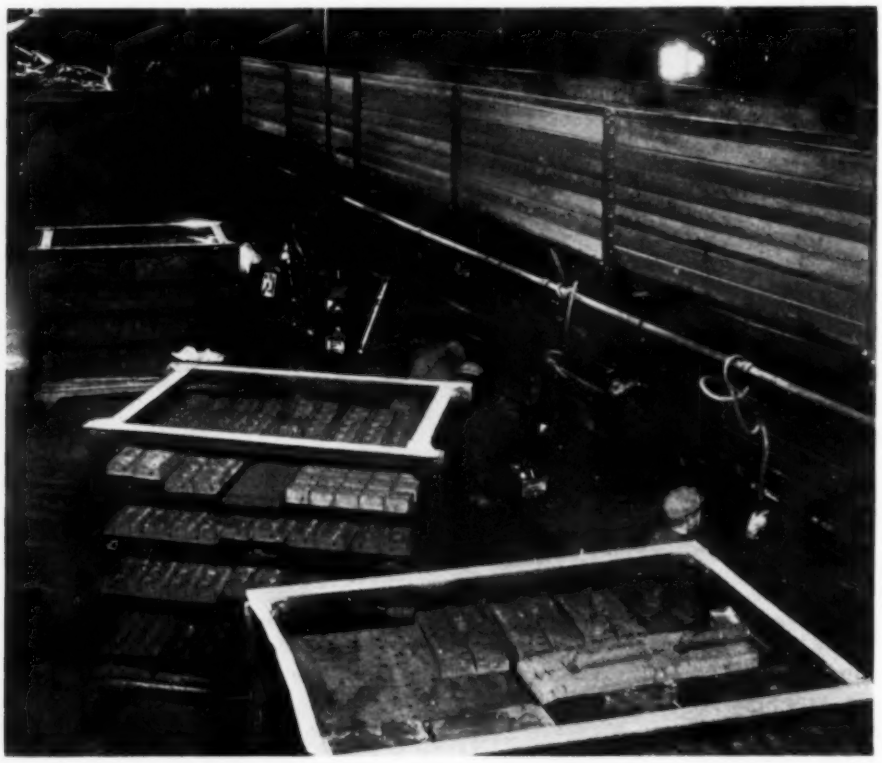


Fig. 18—*Pneumatic Rammers Are Used in the Core Room. The Core Ovens Are Heated with Natural Gas*

The company operates an extensive power house which supplies more than half the electricity for the plants. The remainder is purchased from local sources. The foundry is equipped throughout with 230 volt direct current. In addition to the electrical machinery maintained in the power house three two-stage compressors of 4000 3000 and 2200 cubic feet per minute capacity, respectively, and made by the Ingersoll-Rand Co., New York, are in use. The 3000 cubic foot unit is a turbo air compressor which utilizes exhaust steam from the other equipment. According to the management, that unit also is of interest historically in that it was the second unit of that type made by Ingersoll-Rand Co. In addition to the previously mentioned equipment, two compressors of 1200 cubic feet capacity are held in reserve. Four waste heat boilers made by the Erie City Boiler Works, Erie, Pa., used in conjunction with the casting plant open-hearth furnaces, two 686 horsepower and four 250 horsepower steam boilers fired with natural gas supply the steam required in the operation of the plant.

The storage yard for scrap, pig iron and similar materials, is at the rear and south of the miscellaneous cleaning room. Pig iron and scrap are unloaded in the yard in orderly piles according to kind and analysis. Charging boxes to be filled with materials that make up the charges for the open-hearth furnaces are pushed into the yard on charging cars and loaded by two gantry cranes. One of those cranes has a 75-foot span and 700 feet of travel while the other has the same span but travels only 600 feet. The company purchases an appreciable tonnage of sheet scrap and flashings to be used as charging materials. To reduce the melting loss and facilitate handling it has installed a baling machine in the yard. Other equipment used in loading and unloading materials in the yard includes two locomotive cranes supplied by the Link-Belt Co., Chicago.

This is the second and concluding article describing the manufacture of railroad castings at the Scullin Steel Co., St. Louis.
—The Editors.

Presents Sand Unit to Carnegie Tech

National Engineering Co., 549 West Washington boulevard, Chicago, has presented the sand handling and preparing unit shown at the Cleveland convention of the American Foundrymen's association, to the Carnegie Institute of Technology, Pittsburg. This unit is a one-quarter size complete sand preparing and handling system consisting of a shakeout grate and hopper from which the sand is conveyed on a shakeout belt conveyor. The belt is equipped with a magnetic head pulley at which point all magnetic refuse is removed. The sand is then elevated in a belt bucket elevator, with automatic takeups and of special design, and discharged into a revolving hexagonal screen where the sand is screened and dropped into a storage bin. This storage bin is arranged with two discharge openings which are equipped with duplex gates. Under this bin are two batch measuring hoppers, each holding one batch of sand of the proper size for the small sand mixer. This mixer is an exact duplicate one-quarter size.

Companies Consolidate

William Swindell & Bros. and American Dressler Tunnel Kilns, Inc. have combined to form the Swindell-Dressler Corporation with offices and plant at Pittsburgh. William Swindell & Bros. have built furnaces for the steel and allied trades for the past 80 years. At the present time they manufacture a complete line of combustion and electric furnaces for ferrous and nonferrous melting, heat treating, annealing, etc.

American Dressler Tunnel Kilns, Inc. design and build continuous furnaces for heat treating and annealing. Two other companies, the Gas Combustion Co. and Duquesne Burner Service Co., are included in this consolidation.

Officers of the Swindell-Dressler Corporation include; John F. Casey, president; Philip Dressler, William H. Cosgrove, Frank W. Brooke and Ralph W. Porter, vice presidents; Samuel B. Casey, treasurer; Ralph E. Wittaker, secretary; H. W. Paret, Jr., manager burner division; L. A. Vincent, sales manager.

Bill Again Brings Up The Keel Question

By Pat Dwyer

MANY a time and oft—to borrow a line from the late Mr. Shylock, an acknowledged authority on the gentle are of borrowing and lending—many a time and oft while passing through the public square of this fair city, I have speculated idly on the present status and history of the hundreds of men who occupy the seats and who perch on the grass plot railings like so many large unwieldy birds.

Occasionally I have been tempted to perch by the side of one of these gentlemen and engage him in conversation, but invariably I have been restrained by the reflection that he might resent such a display of familiarity. I never could hit upon a sufficiently felicitous phrase to open the conversation, one calculated to place the party of the second part at his ease and allay any justifiable feeling of suspicion.

On the other hand I realized that such a move on my part laid me wide open to a touch. It was tantamount to walking with my eyes wide open into the lion's jaws. Rarely a day passes that I am not stopped by one or more lads who simply are famishing for a cupacawfee. Why they invariably crave a single cup of this beverage, always has been a mystery to me. If one of these lads is brave enough to stop me while I am hurrying about the master's business, stop me deliberately to tell me of this craving, what would he not do to me if he had me, you might say, in his clutches? Taken on the fly, he has to work fast and confine himself to a simple request all in one compound word. With a victim seated peaceably by his side he could elaborate to a considerable extent and nick me for the price of several cups and the fare home to Squeedunk where he has a swell job waiting for him. An experience the other evening has convinced me that I have been doing these birds of passage a grave injustice. It may be that inadvertently I picked an exception, but the fact remains that I was entertained highly for an hour, in a place where I never expected anything of the kind.

Through a combination of circumstances I found myself with an hour to spare down town between the hours of 7 and 8 p.m. Earlier in the day I had promised a certain lady, related to me through marriage, to meet her at the latter hour and escort her to a show. The show, by the way, was a washout, but that is neither here nor there.

At one time, if my memory serves me correctly, this lady had promised to love, honor and obey me. Over a long period of years her memory appears to have been in fairly good working order on the first point. I regret to say that the memory does not seem to function so accurately on the second point. On the third point her memory not only has collapsed completely, but by a peculiar form of feminine reasoning, she has arrived at the conclusion that it was I who subscribed to the third item in the articles of war.

The foregoing really has no bearing on the present discussion. I merely introduced it here for the benefit of any snooty reader who may be inclined to wonder why I was loitering down town among the pigeons and other birds, when I should have been at home, roosting on the veranda and manfully defending my right to a few hours of peace and relaxation.

Briefly, I was there because I was there. An explanation sufficiently explicit and convincing for any benedict.

After partaking of a modest repast, in which a pig's knuckle figured prominently, I lighted a stogie, purchased an evening paper and rambled over in the direction of the fountain. My intention was to find an unoccupied bench where I could drape myself comfortably and scan the news of the day as set forth under more or less screaming headlines.

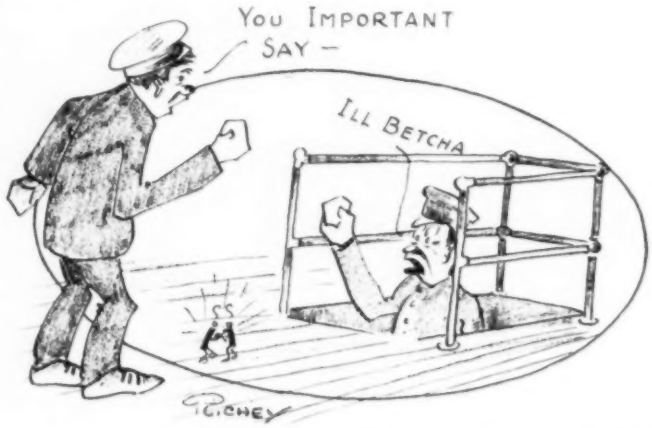
Through long association I was immune to the roar of traffic and the lure of watching hurrying crowds scurrying hither and yon like so many ants in hills I had kicked over carelessly when a boy. I anticipated no interruption in the peaceful program I had mapped out. All of which just goes to show, if an illustration is needed, how uncertain is our progress through this vale of tears. At first glance all the seats appeared to be filled. Here, I reflected is a nice state of affairs. A fine upstanding, hard working citizen, the present speaker, no less, comes to the public square with the laudable intention of resting his hands and feet and what does he find? All the seats pre-empted by a gang of loafers. Something rotten in the state of Denmark. About time for some trusty citizen to take his pen in hand and write to the papers about it. A good stinging

THE DEEP SEA ROVER SPINS A LITTLE YARN

letter, to jolt the civic administration out of its smug lethargy and make the members realize that citizens had some rights.

A more careful survey showed me a bench with only a single occupant. I should have preferred one all to myself, but on the principle of any port in a storm, I decided to grab the seat, before some more enterprising individual beat me to it. With a paper spread in front of me ostentatiously, I felt that I would be reasonably secure from any advances on the part of my companion.

He was a thin, cadaverous looking lad with a pair of piercing black eyes, a prominent nose and an apology for a chin. An iron kelly, or dip, of ancient vintage was supported principally on a pair of generous ears. The same generous proportions characterized his wrinkled coat. Possibly it—the coat—may have fitted him at one time, but if so he had become sadly deflated. His collar, tie and shirt front conformed to the present mode of what the well dressed man is wearing. They also showed evidence of long and valiant service. As if to compensate for the reckless prodigality of material in the coat, a pair of tight trousers terminated slightly above the ankles and exposed heavy knitted socks. The sight of these relics of the stone age aroused long dormant memories of a little fellow creeping around before daylight in the snow of a foundry yard seeking a flask or flasks in which to put up the day's work. The heavy knitted wool socks undoubtedly were an important contributory factor in carrying the aforesaid youth through this trying period.



EXCHANGE OF PLEASANTRIES BETWEEN DECK AND ENGINE ROOM

The same style of socks made life endurable while the boys were waiting for Christmas to release them from the trenches—and for some time afterward. Hunters and trappers wear them inside their moccasins, the *bottes sauvage* of the bare and lonely places where the drifted snow lies wide and deep. Men wear 'em in the sugar bush, in lumbering, mountain climbing, in aviation, in polar exploration. They wear them—and with good reason—in every place where refrigeration conditions prevail and where a pair of warm feet is more to be desired than money in the bank or an uncle with one foot in the grave.

I readily can appreciate why a man should wear them under any of the foregoing conditions, but why a man should elect to wear them in this city in the middle of summer with the thermometer hovering around 90 degrees, forever will remain one of the mysteries beyond my humble ken. Before we arrived at a sufficiently intimate stage for me to propound such a delicate question I saw the blue Peter flying from a craft in the offing. Her anchor was aweigh. The port watch was tailing aft on the main braces and manifestly, unless I chose to remain ashore, I had better paddle out in the stream and make fast.

In a word, I saw the lady for whom I had been waiting, giving me the eye.

However, before she arrived I learned many interesting things touching on the history and personal views of the heavily socked gentleman who shared my seat on the bench. In strict justice, perhaps I should say the gentleman whose bench I shared. He had occupied it intermittently for several days, while I merely was a casual lodger, a transient who never might sit there again.

With the easy camaraderie of the open road he addressed me familiarly the moment I sat down. In commenting on the incident later, the lady said it was no wonder. He probably assumed I was just another bum like himself. With at least 147 nice places where I might have spent an hour, she could not understand why I should elect to spend it in such a place and in such company. "I hope," she said suspiciously, "I hope you did not sit too close to him?"

I assured her he was a deep sea rover, pickled in brine and so forth, and therefore probably in a highly antiseptic condition. What I did not tell her was that his manner of handling the King's English, was anything but antiseptic. His language was an eloquent testimonial to the broadening effect of travel. These lads who roam the seven seas and touch at all ports on the round world's rim have a marvelous opportunity of extending their vocabulary.

Close and intimate association with the foundry industry over a period of many years and with men of many nationalities, enabled me to recognize many of the expressions. The same case hardening experience rendered me immune to the shock of other terms, highly improper, but technically perfect in their blistering intensity. A curious fact, one over which I have speculated many times, is that the technique of this branch of the language seems to have reached its highest development among the comparatively illiterate.

Some day I hope the *Literary Digest* will take a straw vote on this subject and settle the question once and for all time—as it so ably has settled others. Without preamble of any kind, in fact just as casually as if it was the continuation instead of the beginning of a conversation, my bench mate informed me that this is not a nice town. The picturesque manner in which he employed figures of speech to illustrate his meaning, indicated that he held pronounced views on the subject. A few moments before, I had been contemplating the advisability of writing a stinging letter to the papers, complaining of the intolerable prevailing conditions which prevented a citizen from securing a seat in a public park. Now I had a seat and consequently a changed and more tolerant viewpoint. As one who voluntarily had become a citizen of this fairest city on the lakes I could not tolerate such heresay. As Bill remarked when I related the incident to him later, I could not let no out of town bird get away with that kind of stuff. Further qualifying this patriotic sentiment, Bill said I should have told this low fellow that if he did not like the town he knew where he could go.

Unfortunately—or fortunately—depending on the point of view—I do not share Bill's delight in balancing a chip on the shoulder. I told the kicker, that after a residence of many years in the city I had no fault to find with it. I might be prejudiced. I admitted that every man had a right to his own opinion, but I should be interested to learn why he condemned the place so heartily.

Would he tell me? Oh, boy, would he! Would a cat welcome an in-

vitation into a dairy? Here he was with a chief's ticket and he could not get a job in this unmentionable town. To break the monotony every summer for several years he had quit blue water and looked after the coffee-mill on one of the big freighters that sail between Cleveland and the head of the lakes. Never been turned down before. This summer with half of the fleet lying idle he could not get a berth. Was it his fault the boats were idle? Something wrong somewhere. The whole thing was just a conspiracy on the part of the big owners to grind the face of the honest workingman a little deeper in the mire. Here was one boy they were not going to grind. On the morrow morn he proposed to start for the eastern seaboard. Traveling by easy stages, depending on the courtesy of truck drivers and other accommodating tourists he confidently expected to arrive in Baltimore, Philadelphia or New York, inside a week. Greatly relieved at getting this load off his mind, his spirits rose and he launched into reminiscences of deep sea experiences with employment agencies, pig headed masters, dumb second and third assistants, and dumber fire hold crews. In a general way I gather that if strict justice ever is dispensed impartially, genuine martyr's crowns will be awarded only to former chief engineers.

When I related the incident to Bill last night, he expressed keen regret that he had not been present.

"This lad," he said, "must have been the original in that story of the captain and engineer who exchanged jobs for a trial."

"What story is that?" I inquired.

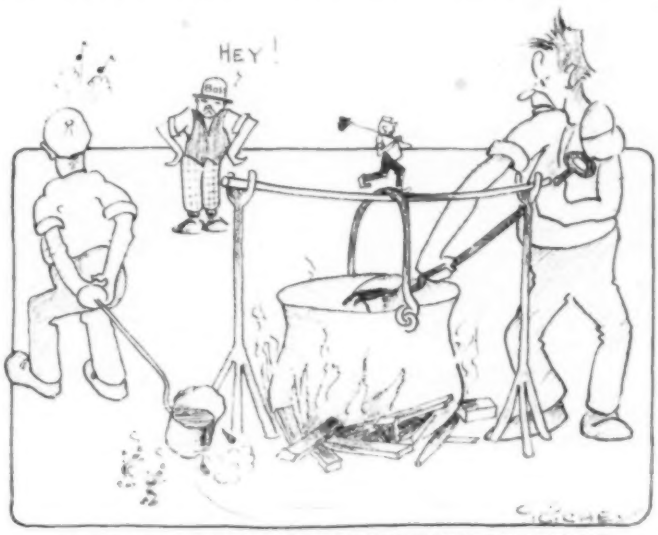
"Why," Bill replied, "it seems that one time a captain and an engineer were continually squabbling over which was the more important. Finally, to settle the argument, they agreed to swap jobs for a day. The chief climbed up on the bridge and the captain disappeared down into the engine room. A few hours later the captain, covered with oil and soot, came fuming upon the deck. One eye was blacked and he looked like one of the survivors of the black hole of Calcutta.

"'Hey, Chief.' he yelled, wildly brandishing a spanner. 'You'll have to come down here. I can't make her go!'

"'I'll tell the world you can't make her go,' the able chief responded, 'and the reason you can't make her go is because she's ashore!'

"Talking about marine affairs," Bill continued, "reminds me that I had a letter recently from a man who read one of your recent articles on making lead keels in wooden molds. He wanted further particulars. He mentioned that I had referred to pouring lead keels in wood molds lightly coated with plaster. He wanted to know what kind of plaster was meant and how thick was it laid on. Also what kind of a furnace usually is employed to melt the metal.

"The plaster employed for coating wood molds in which lead keels are cast, is plaster of Paris. It is mixed quite thin with water and applied rapidly with a brush. The thickness of the coat is negligible and does not affect the size or shape of the lead casing. The practice is not universal. In some yards the molds are not coated with any material. The metal is poured at a temperature just above the melting point and does not burn the wood.



OH, WELL, THE BOYS OUTSIDE THE FOUNDRY ALWAYS DEVELOP THE BEST METHODS

"No standard type of melting equipment has been adopted for melting the metal. This may be due to the fact that the number of lead keels in existence is comparatively small, and to the further fact that lead may be melted so easily. It may be melted in a large iron pot either by building a fire under the pot or by building a fire on top of the lead in the pot. If one pot is not sufficient, two or more pots may be pressed into service. If no pots are available the lead may be melted in a reservoir built of sand above the ground level. In that case the wood mold for the keel is sunk in a pit below the ground level. After the lead is melted it is conducted through a suitable opening in the wall of the reservoir.

"In one yard the metal is melted in a large iron pot provided with a spout at the bottom. This spout remains closed until the lead is melted. Then it is opened and the lead flows through a trough into the mold. In some instances the lead is dipped out of the large pot in comparatively small containers and poured.

"The job can be handled in so many ways that no trouble will be experienced in adopting one to meet the local conditions. Where the melting equipment is inadequate to handle the entire amount of metal required, recourse is had to what is known in the foundry as *dutchmen*. One or more blocks of metal are cast first and placed in the mold. Then the remainder of the mold is filled with the molten metal. To all intents and purposes the casting is a solid block. In a slight variation of this method, lead pigs are stacked in the mold in open formation to serve the same purpose. Where *dutchmen* or lead pigs are employed, proper precautions must be taken to prevent them from floating when they become submerged in molten metal of a like specific gravity. The best method for doing this, also depends on local conditions, particularly on whether the mold is poured with or without a cope. Wood blocks will serve for chaplets. If necessary the holes may be filled afterward with molten lead and the surface finished with a blow torch.

"The job of casting one of these keels is greatly simplified if it is taken to an iron foundry. The metal is melted in a cupola without a blast. Usually the job is reserved until the daily iron heat has been poured. Then the blast is shut off and the lead is charged. A suitable ladle is placed under the spout and the tap hole is left open in the cupola. The metal starts to run out almost immediately and will continue to run as long as it is charged in at the top."

Thompson A. Lyon, for the past ten years superintendent, Davis & Hemphill Co. Elkridge, recently was appointed plant superintendent, Alexander Milburn Co., Baltimore, manufacturer of oxyacetylene apparatus, portable carbide lights and paint and lacquer spray equipment. Mr. Lyon has had a wide experience in mechanical engineering, during the past 14 years.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Classifies Alloy Scrap

THE prophecy has been made that five years hence, steel foundrymen will be unable to secure scrap that contains no alloys. If that comes true, some method of separation of alloyed from plain carbon scrap must be adopted. For alloys must be eliminated from plain carbon steel castings if a uniform product is to be manufactured. Another factor is the possibility that foundrymen may use the alloyed scrap in alloy steel heats with a consequent reduction in the alloy additions to the bath. This would produce a large saving.

CENTRAL ALLOY STEEL CORP., Massillon, O., and the Ford Motor Co., Detroit, have been faced with the alloy scrap problem. Both companies have saved thousands of dollars annually by training men to classify steel by the spark grinding test. In the Central plant, not only is plain carbon separated from alloy steel, but various classifications of alloy steels are segregated. The latter company also has adopted the same method with remarkable savings. Steel foundrymen will watch the trend in scrap and be continually on the lookout for alloys. Recently the spectroscope has been advocated as a rapid means of classifying steels.

¶ Incentive Wages Surveyed

WHILE it is not the province of THE FOUNDRY to sit in judgment on wage matters, the relation of methods of payment to production is a factor of foundry operation and therefore, in order. A recent survey of the National Industrial Conference board, New York, gives some pertinent observations on the so-called incentive type of wage payment. It is shown that such methods are valuable in small plants. The advantages shown result from the increased efforts which such systems stimulate the worker to put forth and the attraction offered. The latter may bring to such small plants a class of workmen of more than ordinary ability. In other words, the small plant would not be so attractive to the skilled artisan without some additional increment of earning power afforded. When the results of an incentive wage system are not satisfactory, the cause often is found in inadequate supervision. Systems which may tend to promote efficiency and increase output have failed entirely when unintelligently installed and laxly administered. The report, which is available for distribution, is entitled "Systems of Wage Payment."

¶ Steel Output Grows

STATISTICS recently issued by the American Iron and Steel institute show that production of steel castings in 1929 broke all records in the history of the industry. Not even in the war years, when the demand for engineering materials pushed foundries to the limit of capacity, did the output of cast steel reach such a high total. The production of the year was 1,583,040 gross tons, a gain of 364,253 tons or 30 per cent over the output in 1928.

A BREAKDOWN of production figures presents interesting sidelights on trends of melting processes employed in steel foundries. The output of open-hearth steel was the largest since 1923, with a total of 1,132,289 tons. This was divided into 588,213 tons of basic and 544,076 tons of acid, the former showing the greatest gain over the previous year with an increase of 55 per cent compared with 18 per cent for the acid process. For the first time in five years, the production of bessemer steel showed an increase over the previous year with a total of 30,829 tons, a gain of 2379 tons. The production of crucible steel continued to decline and for a second time in 15 years fell below 1000 tons. On the other hand, the march of electric steel continued, with a total production of 419,039 tons, an increase of 70,471 tons over 1928. The production of alloy steel castings showed a gain of 14 per cent, the greatest in years, with a total of 192,920 tons.

IN VIEW of the slackening in production noted during the first half of 1930, the student of business economy may be interested in the trends in steel castings during the past decade. Since 1921, three distinct production cycles may be noted, each of three years duration. Production was at low points in 1921, 1924 and 1927; showed improvement in 1922, 1925 and 1928 and reached the peaks in 1923, 1926 and 1929. While 1930 will show a decrease, statistics supplied by the department of commerce show that the total production for the first three months of the year exceeded the output in the corresponding period in both 1927 and 1928.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

HAROLD S. FALK, vice president and works manager, Falk Corp., Milwaukee, recently was presented the honorary degree of Master of Science by Marquette university in recognition of work done in the promotion of the apprentice training movement in American industries. Mr. Falk has played a leading part in the apprentice training work which has taken place in the past ten years in American industries. In addition to building up an effective apprentice training system in his own plant, for ten years Mr. Falk has been chairman of the apprenticeship committee of the National Metal Trades association in Milwaukee and under his direction the number of apprentices in the machinery building industries of the city has grown from about 400 in 1920 to 1100. Mr. Falk also is a member of the advisory committee on apprenticeship to the Industrial Commission of Wisconsin, a member of the committee on education and training of the American Society of Mechanical Engineers and chairman of the committee on education of the National Metal Trades association.

Carl Bauman has been appointed foreman of the Rock Island Stove Co., Rock Island, Ill.

E. W. Cooney, manager of Anderson Engine & Foundry Co., Anderson, Ind., has been elected president of the Anderson Rotary club for the ensuing year.

John H. Coghlan has been appointed New England representative for American Manganese Steel Co., Chicago Heights, Ill., with headquarters at 92 Broadway, Cambridge, Mass.

M. E. Wilcox formerly associated with the Weber Engine Co., Kansas City, Mo., recently has become affiliated with the Progressive Brass Mfg. Co., Seventeenth & Cherry streets, Kansas City, Mo.

Werner Finster, formerly foundry metallurgist of Deere & Co., Waterloo, Iowa, now is connected with the Reading Steel Casting Co., Reading, Pa. as technical supervisor of foundry operations.

Fred L. Obert, associated for the past 36 years with the American Shipbuilding Co., Cleveland, has been appointed general superintendent of the Cleveland plant. He formerly was foundry superintendent.

J. H. Morrison, vice president, Warren Pipe & Foundry Co., New York, was among those injured in the accident to the Colonial Airways plane, which came down in Boston harbor June 5.

Carl H. Morken, formerly plant metallurgist Ohio Brass Co., Mansfield, O., resigned recently to become foundry engineer of the Detroit Electric Furnace Co., Detroit. Mr. Morken, who is a graduate of the University of Minnesota, with considerable practical experience in foundry operation, will be connected with the sales and service division of the Detroit Electric Furnace Co.

CARL H. MORKEN

Albert G. Zima, formerly metallurgical engineer, Western Crucible Steel Castings Co., Minneapolis, has accepted a position with the development research department of the International Nickel Co., New York. Mr. Zima will specialize in research work dealing with alloy steel castings.

L. D. Brobes, formerly associated with the Weber Engine Co., commercial casting division, and the Standard Brass Mfg. Co., both of Kansas City, Mo. has been made sales manager of the Prier Brass Mfg. Co., Fifteenth and Blue River boulevard, Kansas City, Mo.

W. L. Lewis, formerly assistant comptroller of the Bethlehem Steel Corp., recently was elected vice president, secretary and treasurer of the Chicago Pneumatic Tool Co., Chicago Pneumatic building, 6 East 44th street, New York, succeeding J. G. Grimshaw, who recently resigned.

Eugene C. Bauer recently was elected president of the Kensington Steel Co., 505 Kensington avenue Chicago, succeeding the late Walter Smart McKee. Other officers of the company are as follows: vice president and general manager, Kenneth Jensen; treasurer, Walter F. Mandel; and secretary, L. Garris Alt.

H. R. Beckwith, formerly with the Oliver Farm Equipment Co., Chicago, has been appointed head of the Belle City Mfg. Co., Racine, Wis. Mr. Beckwith has had a long experience in the farm implement industry. He formerly was assistant sales manager of the former Oliver Chilled Plow Works, South Bend, Ind.

The honorary degree of doctor of science was conferred upon James T. MacKenzie, chief chemist of the American Cast Iron Pipe Co., Birmingham, Ala., by the University of the South, Sewanee, Tenn., at the graduation exercises held June 10. Dr. MacKenzie graduated from the University of the South in 1912 and later completed master's degree work in chemistry. He has been with the American Cast Iron Pipe Co. since 1914.

C. C. Commons, has been made first vice president and assistant secretary of Foote Bros. Gear & Machine Co., Chicago. F. A. Emmons has been appointed vice president in charge of gear and reducer sales and advertising. Other appointments are H. H. Bates, vice president in charge of the road machinery division; W. A. Barr, vice president in charge of manufacturing; and W. J. Heineman and W. O. Bates, Jr., assistant vice presidents. These positions recently were created by the company.

H. C. Hoover, superintendent of the Springfield, O., plant of Ohio Steel Foundry Co., Lima, O., since early in 1928, has been transferred to Lima as superintendent. He succeeds C. M. Zipf, now superintendent of the company's Bay City, Mich., plant For the time being a superintendent

will not be appointed at Springfield, the work being divided among various foremen. Prior to becoming identified with Ohio Steel Foundry Co., Mr. Hoover was general foreman of No. 1 foundry, Hubbard Steel Foundry Co., East Chicago, Ind.

Gray Iron Institute Adds Members

Recently, the application for membership of T. Main & Sons, Pty. Ltd., East Melbourne, Victoria, Australia, was favorably acted upon by the Gray Iron institute. Some months ago the institute enrolled the Porto Rico Iron Works Inc., Ponce, Porto Rico. These additions together with new memberships in Canada mean that the Gray Iron institute is becoming an international organization.

The following companies also, recently have become members: Prier Brass Mfg. Co., Kansas City, Mo.; Rogers Iron Works Co., Joplin, Mo.; American Laundry Machinery Co., Rochester, N. Y.; Gra-Iron Foundry Corp., Marshalltown, Iowa.

Oakland Apprentices to Attend School

Foundry apprentices located in and near Oakland, Calif., will be required to attend school one-half day per week and will be paid for the time spent there. The East Bay Foundrymen's association has enlisted the co-operation of state and local boards of education in the erection of a properly equipped school building to be completed this year, and foundry apprentice training courses will be instituted. State and local boards of education share the cost of the new school building and courses of instruction will be developed with the aid of the Foundrymen's association.

Foundrymen Hold Outing

The fourth annual outing of the Philadelphia Foundrymen's Association Inc. was held Wednesday, June 11, at the Old Mohican club, Morrison-the-Delaware, N. J. The afternoon was given over to various sports including volley ball, obstacle golf, quoit tournament, etc., followed by the annual base ball game between the foundrymen and supplymen. Dinner at 6:30 completed the activities of the day. R. E. Blazo, Hickman Williams & Co., Philadelphia, was chairman of the outing committee.

St. Louis Founders Elect

St. Louis district Foundry club held its annual meeting and election of officers at the June 5 meeting. The following officers were elected for the ensuing year: President, H. R. Culling, Carondelet Foundry Co.; vice president, J. E. Mellow, Liberty Foundry Co.; and secretary-treasurer, Leo J. Filstead, Kupferle Foundry Co. The following directors also were elected: F. J. O'Hare, Central Brass Co., St. Louis; R. M. Hill, St. Louis Casting Co., East St. Louis, Ill.; H. P. Hubbell, Semi-Steel Casting Co., St. Louis; A. J. Belzer, Banner Iron Works, St. Louis; F. P. Rogers, Excelsior Foundry Co., Belleville, Ill.; and W. Raithel, Century Electric Co., St. Louis..

Foundry Association Directory

American Foundrymen's Association

President, FRED ERB, Erb-Joyce Foundry Co., General Motors building, Detroit; executive secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, GEORGE W. THORNBURG, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. BONNER, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Hubbard Steel Foundry Co., East Chicago, Ind.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, JAMES L. MAHON, American Car & Foundry Co.; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. BULL, Assistant Director, C. N. RING; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary, ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J.; secretary, G. W. HANNAY, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, ERNEST F. STOCKWELL, Barbour-Stockwell Co., Cambridge, Mass.; secretary FRED F. STOCKWELL, 205 Broadwny, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, DON MCDANIEL, Hamilton Foundry & Machine Co., Hamilton, O.; secretary, ROBERT HOIERMAN, 418 Penton building, Cleveland.

Pacific Coast Founders Association

President, CHARLES J. P. HOEHN, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. TRUITT, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary, EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. TROUTMAN, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, R. L. EICHMAN, Bettendorf Co., Bettendorf, Ia.; secretary-Treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis. Meeting the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, JOHN S. SCHOFIELD, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. DUNN JR., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, GEORGE BATTY, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York. Meetings: Cleveland, May 12-15, 1930.

Tri-City Technical Council

Chairman, C. F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. XANDER, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. ERHART, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM J. SNYKER, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. HORNSBY, Joplin, Mo.; secretary, E. L. GRAHAM, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. BORNFLETH, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

Whiting Makes Changes in Sales Personnel

Robert S. Hammond, formerly district sales manager at Chicago for the Whiting Corp., Harvey, Ill., has been appointed sales manager of that firm. Rudolph E. Prussing, vice president, formerly in charge of sales at Cleveland, has been appointed Chicago district sales manager with headquarters at the new Chicago office at 20 North Wacker drive. Ray H. Moore, previously manager of the foundry equipment department of the company, has been appointed district sales manager in charge of the Cleveland office, 624 Penton building.

Mr. Hammond spent two years in the Granite City, Ill., shop of the American Steel Foundries after his graduation from the university of Michigan in 1911. He then was transferred to the sales department of that company with the general offices in Chicago, where he served in railway specialty sales development and later

ROBERT S. HAMMOND

as sales agent. In 1919 he joined the Whiting Corp., taking charge of the Pittsburgh territory. Since 1921 he has been district sales manager with headquarters in Chicago.

After graduating from Cornell university in 1904, Mr. Prussing was connected with H. M. Byllesby & Co. for four years. In 1908 he joined the Whiting Corp. working in turn in the engineering, estimating and sales department. From 1917 to 1926 he was district sales manager at Detroit. In 1926 he returned to the Harvey office and was elected vice president in 1927. In 1928 he was appointed district sales manager at Cleveland where

RUDOLPH E. PRUSSING

he continued until his present appointment.

Mr. Moore was born in Cleveland in 1892 and lived in that city until 1912. In 1910 he became connected with the Premier Vacuum Cleaner Co., Cleveland, as mechanical engineer and remained with that company until 1912. From 1912 to 1913 he managed the Premier Vacuum Cleaner Co.'s Canadian plant at Hamilton, Ont. He then became connected with the H. C. Frick Coke Co., Scottdale, Pa., a subsidiary of the United States Steel Corp., in the capacity of mechanical engineer. In 1916 he was appointed chief engineer of the W. W. Sly Mfg. Co., and in 1920 was made consulting engineer of that company. From 1922 to 1926 he was consulting engineer with the American Foundry Equipment Co., Mishawaka, Ind. Since 1926 Mr. Moore has been manager of the equipment division of the Whiting Corp.

Gives Conveyor Data

A book of conveyor information recently has been published by Palmer-Bee Co., Detroit. The book of 79 pages, is intended for the business executive, plant engineer and buyer interested in conveyor installations. Design drawings are given showing the elements of the various conveyor systems made by the company. Sectional photographs are used to show construction details. The book is well illustrated with views of typical conveyor installations in foundry and other industries. Size and capacity data are given for the various designs shown as well as various items of information useful in selecting equipment.

Three Steel Foundries Consolidate

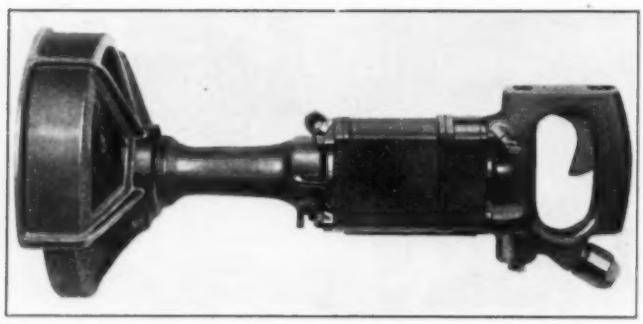
Consolidation of the Hubbard Steel Foundry Co., East Chicago, Ind., Duquesne Steel Foundry Co., Pittsburgh, and Wheeling Mold & Foundry Co., Wheeling, W. Va., into an organization to be known as the Continental Roll & Steel Foundry Co., has been announced in Chicago by the firm of Cochran, Scott & Co., investment brokers.

The new chairman of the board of the Continental Roll & Steel Foundry Co. is Albert Pack, formerly chairman of the board of Hubbard Steel Foundry Co. J. T. Osler, formerly president of the Hubbard company, is president of the Continental company. Donald C. Bakewell, formerly president of Duquesne Steel Foundry Co., becomes vice president, as do Herbert E. Field, former vice president of Wheeling Mold & Foundry Co.; William E. Trautman, former vice president of Duquesne Steel

RAY H. MOORE

Foundry Co.; and W. H. Seaman, former vice president of Hubbard Steel Foundry Co. D. R. Wahlberg is secretary-treasurer.

In addition to these officials the directorate consists of Harold Beacom of Winston, Strawn & Shaw, Chicago; D. A. Burt, chairman of the executive committee, Wheeling Mold & Foundry Co.; Andrew H. Scott, president of Cochran, Scott & Co.; J. J. Shinners, vice president of H. M. Byllesby & Co., Chicago, and Howard Whitehouse, vice president of the Continental Illinois Co., Chicago. Main offices of the new company will be in Chicago, at least for the present.



THE GRINDING MACHINE WEIGHS 13½ POUNDS

Introduces Portable Air Grinders

Independent Pneumatic Tool Co., 600 West Jackson boulevard, Chicago, has introduced a new line of pneumatic grinders based on the rotary principle. The advantages claimed for the machine are light weight, governed speed, increased power, minimum vibration and reduced operation costs. The new line covers a range of sizes and types for all requirements. It ranges from grinders having a speed of 28,000 revolutions per minute and carrying a 1¼-inch elastic bonded wheel to those having a speed of 4300 revolutions per minute and supplied with an 8-inch elastic bonded wheel. The grinder shown in the accompanying illustration may be equipped with an 8-inch elastic bonded wheel or a 6-inch vitrified wheel. The machine weighs 13½ pounds.

Research Would Improve Steel Castings

Elimination of pin holes in steel castings poured into moist sand molds, and the necessity for maintaining higher strength and ductility in answer to the demands of industrial users has become the subject of extensive research by the bureau of standards, Washington, which has carried out preliminary investigations on the subject. In the work, a study was made of the strength, ductility, and soundness of steel castings involving many foundry variables. If the composition was maintained between 0.10 and 0.17 per cent carbon, the manganese between 0.60 and 0.70 per cent, and the silicon between 0.30 and 0.40 per cent, the addition of the customary aluminum shortly before pouring was found to give steel castings which were usually within the specified limits of ductility after the heat treating operation.

When the carbon was too low there was found to be danger of not meeting the tensile strength requirement of 60,000 pounds per square inch. The variables having the greatest effect on ductility were found to be metals used for degasification or deoxidation. None of these deoxidizers, such as ferroboron, silicon, berryllum, etc., were superior to aluminum in producing soundness. Some experiments were made with mold preparations in the form of surface treatments with aluminum and powdered deoxidizers for counteracting the mold moisture, but the experiments were not promising. It was found, however, that a sufficient amount of deoxidizer should be in the steel at the time of pouring to deoxidize the steel from any gases evolved from the moisture of the mold.

Steel Founders Publish Results of Survey

The Steel Founders' Society of American, Inc., 932 Graybar building, New York, recently published its "1930 Directory of Manufacturers, Steel Castings, Heat and Corrosion Resisting Castings in the United States and Canada." This directory presents a survey of capacity, equipment, and production data for 260 foundries in the United States and 17 in Canada. The summaries and statistical charts in the back of the book give a quick picture of various classifications in detail and total.

The directory will be found a valuable reference book to those interested in the steel foundry industry and may be obtained from the headquarters of the society, 932 Graybar building, New York.

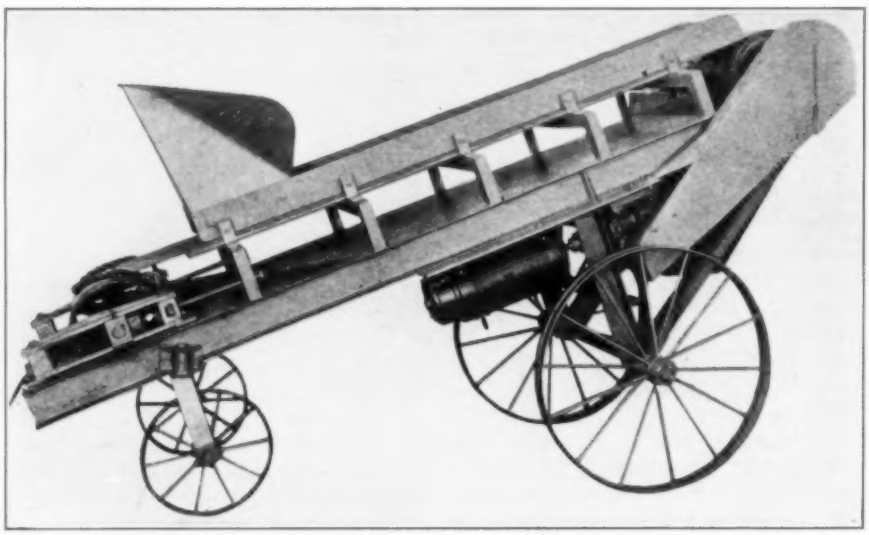
New Magnetic Separator Is Portable

Beardsley & Piper Co., Chicago, has introduced a new electric magnetic separator unit. Until recently the company has manufactured this type of separator only for use with belt conveyor systems. The flexibility of the portable unit makes it applicable to handling processes where iron or steel shot or tramp iron contaminate the products being handled.

The new portable magnetic separator unit, as shown in the accompanying illustration, consists of a short belt running between two pulleys, the magnetic pulley being at the head or drive end. Metal parts or shot are picked up by the magnetic pulley and are carried over into a suitable discharge chute. The drive is new in application, consisting of a motor generator set, the motor of which drives the belt through a speed reducer and chain while the generator furnishes direct current at correct voltage for the magnetic separator. This gives a unit that requires only one connection to the power supply—it may be either direct current or alternating current as desired. The entire unit is mounted on a sturdy steel frame supported by two large wheels at the head end and two small wheels at the foot end.

Frecker Bros., Inc., 30 Church street New York have been appointed representatives of N. A. Strand & Co., 500, North Lincoln street, Chicago. The new representatives will handle the sale of flexible shafts and equipment in eastern New York and northern New Jersey.

Atlas Steel Casting Co., Buffalo, shortly will move its New York office to the Lincoln building, 30 East Forty-second street.



THE MAGNETIC SEPARATOR REMOVES FERROUS SCRAP FROM THE SAND

Trade Trends in Tabloid

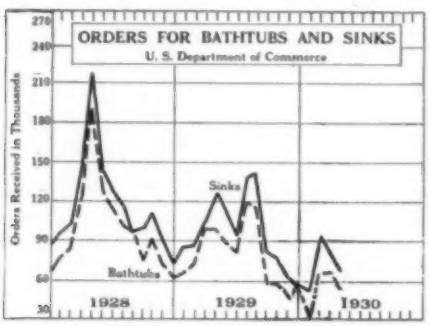
AFTER rising during every month since last November, construction awards dropped slightly in May, according to the F. W. Dodge Corp. Awards in May for the 37 states east of the Rocky Mountains totaled $482,876,700, a loss of 5 per cent over April and 22 per cent over May, 1929.

—T—T—

Production of malleable castings in May totaled 53,729 tons compared with 62,035 tons in April, according to the department of commerce. The industry operated at 53 per cent of capacity during May.

—T—T—

Slight gains have been noted in gray iron foundry operations in the



East. Reports also indicate that this improvement gradually is extending westward.

—T—T—

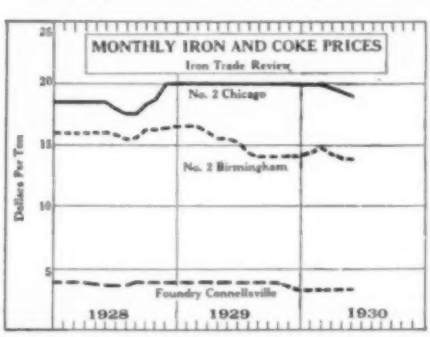
Index of orders for foundry equipment in May was 92.7 compared with 122.8 in April, according to the Foundry Equipment Manufacturers association. The index of shipments in May was 149.4 compared with 217.4 in April. Unfilled orders for May were 179.3 against 291 in April.

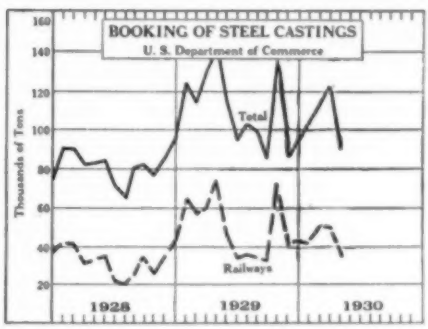
—T—T—

Slackening demand has caused many makers of machine tools to reduce operations. May orders dropped approximately 25 per cent from the April total.

—T—T—

Loadings of revenue freight turned





upward sharply the first week in June. Movement of regular freight in the week ended June 7 amounted to 935,647 cars.

—T—T—

Combined deliveries of brass and bronze ingots and billets made by members of the Nonferrous Ingot Metal institute during May amounted to 6885 tons, an increase of 844 tons or 13.9 per cent over April.

—T—T—

Stove and heating apparatus manufacturers in the St. Louis district are begining to stock pig iron against the demand expected in the near future.

—T—T—

Production of automobiles in May totaled 417,154 cars compared with 442,835 cars in April. This output compared favorably with the production in May during the past ten years. The total has been exceeded four times, but with the exception of 1929,

RAW MATERIAL PRICES
June 23, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	18.50
No. 2 foundry, Buffalo	18.50
Basic, valley	18.50
Basic, Buffalo	18.00
Malleable, Chicago	18.50
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$16.00
Heavy melting steel, Pitts	14.50 to 15.00
Heavy melting steel, Chicago	12.00 to 12.50
Stove plate, Buffalo	11.00 to 11.25
Stove plate, Chicago	9.50 to 10.00
No. 1 cast, New York	10.25
No. 1 cast, Chicago	12.50 to 13.00
No. 1 cast, Philadelphia	14.50 to 15.00
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.50 to 14.00
Agricultural mal., Chicago	12.50 to 13.00
Malleable, Buffalo	15.50 to 16.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	11.75 to 11.87½
Electro, copper, producers	12.00
Straits, tin	29.75
Lead, New York	5.40
Antimony, New York	7.00
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	15.50
Zinc, East St. Louis, Ill.	4.30 to 4.32½

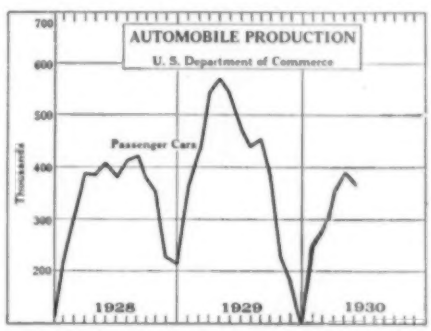
the difference has not been great. The production for the month of May in 1925 was 419,056; in 1926, 425,167; in 1928, 425,783; and last year, 604,691.

—T—T—

Freight car builders at Chicago have practically worked off their orders. Buyers have held off closing on the 3200 cars now pending, until after the June meeting of the American Railway association.

—T—T—

Foundry operations in the Chicago district have declined a few points from early in June, the general average being about 60 per cent. Steel foundry operations are fair, but low production in gray iron and nonferrous shops brings down the average.



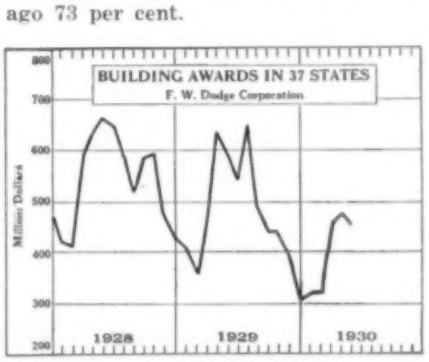
Gray iron and brass shops are casting three to four days a week while activity in aluminum foundries averages barely three days.

—T—T—

Orders were placed for 89,687 tons of steel castings in May compared with 92,966 tons in April, according to the department of commerce. Railway specialty orders increased from 35,213 tons in April to 41,252 tons in May. Production dropped from 77 to 72 per cent of capacity with a total of 103,405 tons in May.

—T—T—

Steel plant operations for the third week in June averaged 68 per cent compared with 71 per cent the preceding week. A year ago the industry averaged 96 per cent and two years ago 73 per cent.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Vulcan Plow Co., Evansville, Ind., reports an increased foundry production.

Pekin Foundry & Mfg. Co., Pekin, Ill., D. P. Sommer, secretary, is building an addition.

Lewisburg Stove Co., Lewisburg, Tenn., recently suffered fire loss amounting to several thousand dollars.

Fire recently caused $20,000 to $25,000 damage in the plant of the Galt Malleable Iron Co., Galt, Ont. Production was suspended for several days pending repair of the damage.

Three pipe shops of the Central Foundry Co., Holt, Ala., have resumed a six day a week schedule and many additional men have been employed.

Standard Castings of Cincinnati, Inc., has been incorporated with a capital of $35,000 by Frank E. Wood, Robert S. Marx and Loretta E. Tully.

Decker Foundry, Machine & Tool Co., recently has been established at Henryetta, Okla. The company will produce gray iron, semisteel and brass castings.

Alliance Machine Co., Alliance, O., has received an order for a 115-ton single piece anvil base. The casting will be made at the Machine Steel Castings Co., Alliance, O.

DeSoto Foundry & Machine Co., Ltd., Mansfield, La., operating a foundry and machine shop, will expand plant facilities following recent capital increase.

Allied Engineering & Mfg. Co., 98-104 Murray street, Newark, N. J., has been incorporated for the manufacture of metal articles. The company also manufactures a composition for the production of match plates.

Shilling Foundry, Poplar avenue and Henry street, Columbus, O., has made plans since the recent fire loss to part of its foundry, for large plant addition. (Noted June 15).

Otter River Foundry Co., Otter River, Mass., will build a new foundry to replace that damaged recently by fire. Contractor for the new construction is Carroll St. Hilaire, Gardner, Mass. (Noted June 15).

General Foundry Co., Anniston, Ala., recently was damaged severely by fire. The loss was estimated at approximately $35,000. According to information no arrangements have been made to rebuild the foundry.

Swedish Crucible Steel Co., Butler street and Grand Trunk R. R., Detroit, now has two foundry units under construction; the estimated cost is $40,000. Henry M. Freier, 300 Murphy building is the architect.

Deere & Co., Waterloo, Iowa, has awarded contract for a 1-story, 160 x 240-foot manufacturing plant for the production of wheels to Jens Oleson Construction Co., 1522 Lafayette street. The cost of the new construction is estimated at approximately $125,000.

Board of directors of the Akron Foundry Co., Akron, Ind., recently conferred with J. C. Rennels, Columbia City, Ind., who is interested in opening an Akron foundry. Furnace stokers will be manufactured if negotiations are successful.

Specialty Brass Co., Kenosha, Wis., has received an order from the Badeker Mfg. Co., Chicago, manufacturing packing rings for locomotives, for its entire supply of brass castings, on a continuing basis. At the present rate, the order is valued at $40,000 annually.

Johnson City Foundry & Machine Co. Inc., Johnson City, Tenn., is completing a foundry building, 85 x 120 feet. Ovens, cupola and molding machines are being installed. The company will be able to manufacture castings up to 40,000 pounds with the new equipment. (Noted May 1.)

Dunkin Foundry & Machine Works, 102 West 2nd street, Alton, Ill., has purchased a site 240 x 300 feet from the Alton Railway Co. William M. Dunkin is president of the Dunkin Co., which operates a machine and pattern shop and is a manufacturer of bronze, aluminum and gray iron castings.

Beaver Dam Pattern Co., South Center street, Beaver Dam, Wis., advises that J. Seefeldt Contracting Co. has been awarded the contract for a 40 x 95-foot plant to be located at 109 Rowell street. The amount of machinery in the plant will be increased in both the wood and metal pattern departments. A brass furnace is being installed. The new unit will be in operation by Aug. 1. (Noted June 15).

Taylor-Wharton Iron & Steel Co., High Bridge, N. J., has added an alloy steel division for the manufacture of corrosion and heat resisting castings. The line will include marine castings, ornamental hardware and general industrial castings. The new division has been operating for some time and is the result of a year's research.

White Mountain Freezer Co., Inc., Nashua, N. H., recently purchased the foundry formerly owned by the National Bread Wrapping Machine Co., Nashua, and will continue to operate the plant under the latter name. Officers of the White Mountain Freezer Co. are as follows: President, Lester F. Thurber; treasurer and general manager, Eaton D. Sargent; and secretary, Charles E. Johnson.

New Trade Publications

ALLOY CAST STEEL—Sivyer Steel Casting Co., Milwaukee, in the current issue of its reports features a new alloy steel which gives hardness without sacrifice of other valuable characteristics.

ELECTRIC FURNACES—Hevi Duty Electric Co., Milwaukee, has published a bulletin covering 18 standard sizes of box-type electric furnaces, with complete descriptions and specifications.

AIR COMPRESSORS—General Electric Co., Schenectady, N. Y., has issued a folder describing the operating principles and features of its single-stage, centrifugal air compressors for cupola blowing.

TRAMRAILS—Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has published another of its series of folders describing and illustrating typical uses of overhend tramrails in the foundry.

SPECTROSCOPES—Adam Hilger Ltd., London, England, in an 8-page pamphlet, shows the application of spectroscopes for the rapid sorting and checking of stored steel and steel scrap, and for the general control of steel production.

FERROALLLOYS—Paket Alloys Inc., New York, has issued a 4-page folder describing its briquetted ferroalloys for the reproduction of high quality gray cast iron. The folder also includes some of the advantages claimed to result through the use of the briquets.

CUPOLAS—Whiting Corp., Chicago, has issued a pamphlet containing descriptions and design data on its various cupola products. Two leaflets, illustrating design features of charging devices and ladle mechanism, accompany the pamphlet.

INDUCTION FURNACES—Ajax Electrothermic Corp., Trenton, N. J., has published a bulletin, No. 6 of a series, covering development and principles of operation of its electric furnaces. Typical installations are shown and data given covering the furnaces and their control units and power generators.

ELECTRIC TOOLS—Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, has issued a 70-page catalog, designated as catalog No. 898, which lists, illustrates and describes the portable electric tools it makes. Electric drills, reamers, tappers and grinders are covered. Portable grinding equipment designed for various shop power systems is covered by data and illustrations.

CONVEYORS—Chain Belt Co., 736 Park street, Milwaukee, has published a 71 page catalog describing and illustrating its bulk material handling equipment. Bucket elevator systems are covered in detail with illustrations of typical uses. Steel apron, and pan conveyors also are described.

FLEXIBLE SHAFT MACHINES—United States Electrical Tool Co., Cincinnati, has published a catalog which includes description and illustration of the flexible shaft attachments and machines made. Special tools for form milling and cutting applicable to pattern and die work are also described.

ALUMINUM CASTINGS—The British Aluminum Co., Ltd., has published a 24-page bulletin giving data on standard aluminum casting alloys, the mixing of alloys, melting practice, pouring, molding practice for sand casting, permanent mold castings and the heat treatment of aluminum alloy castings.

MOTORS—General Electric Co., Schenectady, N. Y., has published an 85-page booklet on the synchronous motors it manufactures. The booklet points out the advantages of that type motor and explains the details of construction and some of the characteristics. Illustrations show the various types. Drawings detail the methods of installation. An extremely large number of reproductions from photographs of typical installations also are shown. The installation illustrations cover a wide variety of uses in many details.

CHAIN DRIVES—Link-Belt Co., 910 South Michigan avenue, Chicago, has published a 96-page, cloth-bound data book coverings its roller chain drives. Drawings and data are given covering the design of the various roller chain assemblies build up from the links and rolls made by the company. Useful data on speed, horsepower and arrangement is given in connection with roller chain drives. Sprocket wheel data and price lists are given. The latter part of the book is devoted to illustrations of typical uses of the company's products with several pages and tables of general engineering data on power transmission.